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ON THE OCCURRENCE OF GOITRE (ACTIVE THYROID HYPERPLASIA) IN FISH.[1]

By David Marine, M. D., and C. H. Lenhart, M. D.,
Cleveland, Ohio.

(From the H. K. Cushing Laboratory of Experimental Medicine, Western Reserve University.)

Water has been associated with the cause of goitre since the earliest observations and writings on diseases of the thyroid gland. The list of substances that may be present in solution or suspension comprise a great variety of organic and inorganic chemical combinations; also various forms of plant life as algae and bacteria and animal life as protozoa. Of the great variety of chemical substances that have been brought forward as etiological factors the most prominently mentioned have been the sulphides and sulphates of iron, magnesia and calcium and also the carbonates of calcium and magnesia. Of the extensive bacterial analyses conducted by Bircher, Kocher and others, no definite conclusions have been reached. During the past year, McGarrison working with endemic cretinism in the Himalaya mountains has brought forward certain amoebæ as etiological factors.

Summing up our acquaintance with the vast literature dealing with water as a causal factor in goitre, we have been quite unable to convince ourselves that there is any proof that the substances thus far described have any causal connection or even that any direct evidence has been presented that water is a causal factor in goitre.

Inasmuch as most of the land animals in goitrous districts have thyroid changes, it occurred to us that by the examination of fish thyroids in such districts one might get more specific information whether water was or was not a factor in the development of goitre.

In the course of our investigation we have examined moun-

[1] Read at the meeting of the Cleveland Academy of Medicine, December 10, 1909.

tain trout from the Yellowstone Park, from Utah and California; sea trout and sea bass from the Atlantic Ocean; gold fish from local dealers; lake pike, lake herring, white bass,

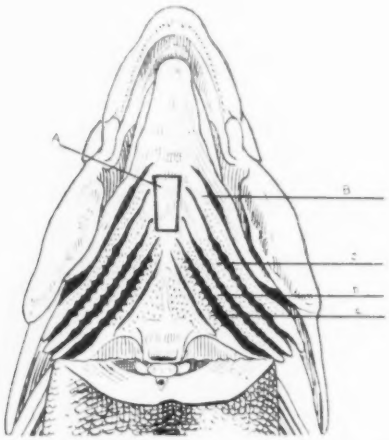

FIG. 1.—Illustrates the location of the thyroid area in the lake pike. It is applicable to bony fish in general. *A* = thyroid area; *B* = 1st gill segment; *C* = 2d gill segment; *D* = 3d gill segment; *E* = 4th gill segment.

sheephead and carp from Lake Erie. We have observed goitrous changes only in the fish obtained from Lake Erie.

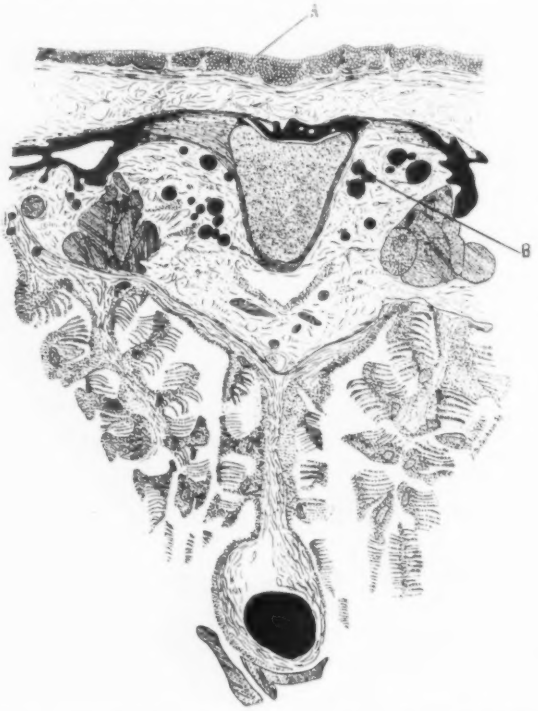

FIG. 2.—Drawing illustrating distribution of normal thyroid follicles in bony fish as seen in transverse section of the thyroid area. *A* = pharyngeal mucosa; *B* = thyroid follicles.

Of the Lake Erie fish, the pike and bass very commonly are affected, while the sheephead and herring are but rarely affected. The carp so far as our observations have extended is not at all affected.

Before describing these goitrous changes in the lake pike and bass it seems appropriate to add a brief account of the normal thyroid gland in the bony fish.

The normal thyroid (Fig. 1) in the several varieties of fish

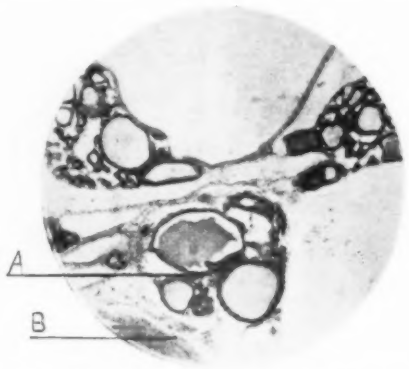

FIG. 3.—Microphotograph illustrating mild degree of thyroid hyperplasia in the lake pike. *A* = thyroid follicles; *B* = ventral aorta.

examined shows only minor individual differences and is also strikingly like the normal thyroid of the higher animals. The gland alveoli are loosely distributed about the ventral aorta between the first and third gill segments and extend outward for slight distances on the second and third gill arch arteries. *The gland is not encapsulated* as in reptiles and amphibia.

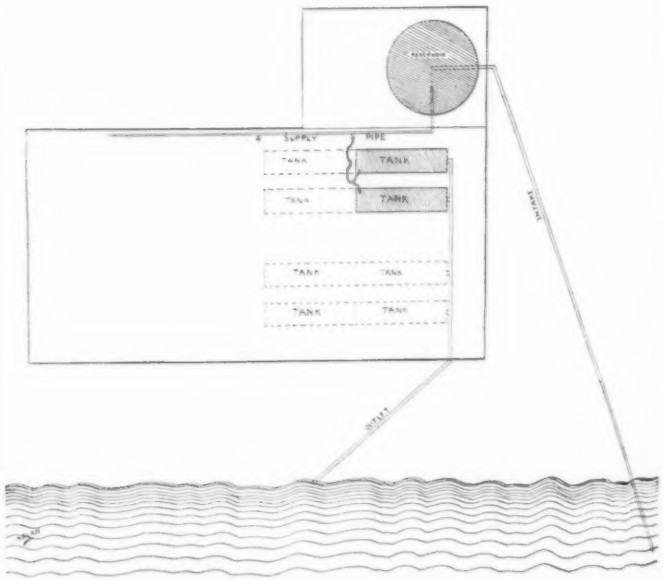

FIG. 4.—Diagram of hatchery showing arrangement of troughs, etc.

The main mass of thyroid lies in the second gill segment and widely scattered alveoli in the alveolar tissue extend anteroposteriorly and laterally from this central mass.

Histologically, the gland is very vascular. Each alveolus is surrounded as in the mammalian gland, with a rich capillary network. The alveoli are rounded and vary in diameter from 0.1-0.5 mm. The size of course depends largely on the age and size of the fish as in other animals. The lining epithelium is low cubical regularly arranged in a single layer with small darkly staining nuclei. The colloid stains uniformly with eosin and comes in direct contact with the lining epithelium. In its general histological appearance therefore, the normal fish thyroid is similar to that of mammals in all its essential characteristics except that there is no capsule (Fig. 2).

In certain Lake Erie fish, as above mentioned, and particularly in the lake pike, we have observed a departure from the normal type above described. This change is similar in all its essential features to the thyroid hyperplasia in mammals as typified by the spontaneous or the induced hyperplasias of dogs or the hyperplasia of exophthalmic goitre in man (Fig. 3).

As in the higher animals so in the fish, there are different degrees of hyperplasia varying from the slightest departure from normal to the marked glandular hyperplasias. The most striking changes are seen in the *blood supply*, in the stainable *colloid* and in the *epithelium*.

The capillaries and larger vessels of the stroma are dilated. The stainable colloid is decreased—but slightly in the early stages while it may be entirely absent in the marked degrees of hyperplasia. The epithelium varies from cubical in the milder degrees to high columnar in the marked degrees of hyperplasia. The infoldings and plications of the lining epithelium are present, though perhaps less marked than in similar degrees of hyperplasia in mammals. This phenomenon just as the suggestive appearance of invasion of the surrounding tissue—bone and muscle—by the hyperplastic gland, is probably due to the lack of a gland capsule and its restraining effect. None of the pike examined has shown thyroid enlargement clinically although it may enlarge so as to be detectable clinically. We have also observed one example of spontaneous colloid goitre in the pike, that is a hyperplasia that has undergone spontaneous recovery just as occurs in the higher animals.

From what we already know of the hyperplasias of the higher animals and from the fact that a similar hyperplasia occurs in fish it could be inferred with practical certainty that spontaneous involution (reversion) of these fish hyperplasias could also occur under favorable conditions of food and environment.

In order to determine whether these thyroid hyperplasias in fish undergo the same kind of involution (reversion) as do the mammalian hyperplasias following the administration of iodin containing substances the following experiment was made:

TABLE 1.—IODIN EXPERIMENT—CONTROLS.

Fish No.	Date taken.	Histological condition of thyroid.		Classification.
		Stainable Colloid.	Epithelium.	
1	Oct. 2	Everywhere present, nearly normal.	High cubical, regular.	Normal-early glandular hyperplasia.
2	" 3	Everywhere present, nearly normal.	High cubical, regular.	Normal-early glandular hyperplasia.
3	" 4	Everywhere present, reduced.	High cubical, regular.	Early glandular hyperplasia, very vascular.
4	" 5	Everywhere present, nearly normal.	High cubical, regular.	Normal-early glandular hyperplasia.
5	" 6	Much reduced, absent from many follicles.	Columnar, regular.	Early-moderate glandular hyperplasia.
6	" 7	Slightly reduced.	High cubical, regular.	Early glandular hyperplasia.
7	" 8	Practically absent.	High columnar, regular.	Moderate glandular hyperplasia.
8	" 9	Present everywhere in follicles, nearly normal.	High cubical, regular.	Normal-early glandular hyperplasia.
9	" 10	Present throughout, reduced.	High cubical, regular.	Early glandular hyperplasia.
10	" 11	Present throughout, reduced.	High cubical, regular.	Early glandular hyperplasia.
11	" 12	Absent.	High columnar, regular.	Moderate-marked glandular hyperplasia.
12	" 13	Present throughout, slightly reduced.	High cubical, regular.	Early glandular hyperplasia.
13	" 14	Absent.	High columnar, regular.	Marked glandular hyperplasia, generalized fibrosis of thyroid area.
14	" 15	Absent.	High columnar, regular.	Marked glandular hyperplasia, well-marked infoldings and plications.
15	" 16	Everywhere present, nearly normal.	Cubical, regular.	Normal thyroid(?)(normal-early glandular hyperplasia).
16	" 17	Absent.	High columnar, regular.	Marked glandular hyperplasia.
17	" 18	Reduced, absent in some follicles.	Columnar, regular.	Early-moderate glandular hyperplasia.
18	" 19	Reduced in all, absent in many follicles.	High columnar, regular.	Moderate glandular hyperplasia.
19	" 20	Reduced.	Columnar, regular.	Early-moderate glandular hyperplasia.
20	" 21	Reduced.	High columnar, regular	Moderate glandular hyperplasia.

Forty-two healthy pike, varying from 30-35 cm. in length, were transferred directly from a Lake Erie pound net to the State Fish Hatchery at Put-in-Bay. Twenty fish were placed in the control trough and twenty-two fish in the trough to which iodin was added daily. These troughs were of the same size (Fig. 4)—their inside measurements being 168 x 31 x 20 inches with 60 cu. ft. capacity. Lake Erie water was supplied to each trough in equal amounts from the reservoir. The inflows were adjusted so as to fill the troughs in eight hours. One cubic centimeter of Lugol's solution (1 gm. iodin, 2 gm. KI., 300 cc. water) was added daily to the contents of one of the troughs. One fish daily was removed from each of the troughs for histological examination. The results of these histological examinations are presented in Tables No. 1 and 2.

By comparing these tables it is seen that the control fishes' thyroids, while exhibiting wide variations in their histological appearance, do not tend to return to the colloid or resting

stage. On the other hand in the fish exposed to the small amounts of iodin from one to twenty-five days, the thyroids do react and return to the colloid or quiescent state. These fish hyperplasias, therefore, react in the same manner with iodin as do the hyperplasias of mammals, viz., the return of the hyperplasias to the colloid or quiescent state and as has been shown for mammals this is the nearest normal condition that thyroids can assume which have once been the seat of active hyperplasias.

These observations are perhaps the most direct evidence that water is in some way (still unknown) associated with the development of goitre. Our observations are still too few to allow of any general statements, although it may be stated that carnivorous fish just as carnivorous mammals are more frequently affected as is shown in the great frequency of these changes in pike and their absence in carp. On the other hand, the two examples of ocean carnivora examined did not show these hyperplastic changes.

TABLE 2.—IODIN EXPERIMENT—EFFECT OF ADMINISTRATION OF IODIN.

Fish No.	Date taken.	Duration of iodin administration.	Histological condition of thyroid.		Classification.
			Stainable colloid.	Epithelium.	
1	Oct. 3	1 day.	Practically normal.	Cubical, regular.	Normal thyroid(?) (normal-early glandular hyperplasia).
2	" 4	2 days.	Present throughout, slightly reduced.	High cubical, regular.	Early glandular hyperplasia.
3	" 5	3 "	Nearly absent.	High columnar, regular.	Moderate glandular hyperplasia, generalized fibrosis of thyroid area.
4	" 6	4 "	Present throughout, somewhat reduced.	Cubical, regular.	Colloid-early glandular hyperplasia, involuting (reverting).
5	" 7	5 "	Present throughout.	Cubical, regular.	Normal-early glandular hyperplasia.
6	" 8	6 "	Present throughout, nearly normal.	Cubical, regular.	Colloid-early glandular hyperplasia, involuting (reverting).
7	" 9	7 "	Present throughout, nearly normal.	Cubical, regular.	Colloid-early glandular hyperplasia, involuting (reverting).
8	" 10	8 "	Normal.	Low cubical, regular.	Normal-colloid.
9	" 11	9 "	Slightly reduced.	Cubical, regular.	Colloid-early glandular hyperplasia, involuting (reverting).
10	" 12	10 "	Present throughout, reduced in all follicles.	Columnar, regular.	Colloid-moderate glandular hyperplasia, involuting (reverting).
11	" 13	11 "	Present throughout, reduced in all follicles.	Columnar, regular.	Colloid-moderate glandular hyperplasia, involuting (reverting).
12	" 14	12 "	Normal.	Low cubical, regular.	Colloid goitre(?) (colloid-early glandular hyperplasia), involution nearly complete.
13	" 15	13 "	Present throughout.	Cubical, regular.	Colloid-early glandular hyperplasia.
14	" 16	14 "	Abundant in all follicles.	Low cubical, regular.	Colloid goitre, complete involution (reversion).
15	" 17	15 "	Present in all, somewhat reduced.	Cubical, regular.	Colloid-early-moderate glandular hyperplasia, rapidly involuting (reverting).
16	" 18	16 "	Normal.	Low cubical, regular.	Colloid goitre, generalized fibrosis, complete involution (reversion).
17	" 19	17 "	Normal.	Low cubical, regular.	Normal-colloid, involution from very early degree of hyperplasia if any hyperplasia at all had occurred.
18	" 20	18 "	Normal.	Low cubical, regular.	Normal thyroid, no evidence of any previous hyperplasia, however slight.
19	" 21	19 "	Abundant.	Low cubical, regular.	Colloid goitre, complete reversion.
20	" 23	21 "	Abundant.	Low cubical, regular.	Normal-colloid.
21	" 25	23 "	Abundant.	Low cubical, regular.	Colloid goitre, complete involution (reversion).
22	" 27	25 "	Abundant.	Low cubical, regular.	Colloid goitre, complete involution (reversion).

This experiment also emphasizes two other features which the fish thyroid hyperplasias have in common with mammalian hyperplasias, viz., the small quantities of iodin and the relatively short time necessary to induce these changes. It can be inferred from these anatomical and experimental observations that hyperplasia of fish thyroids are similar in nature to those of mammals and also that probably the stimulus or stimuli producing the thyroid reaction in fish is similar to that acting in mammals.

To sum up then, we would emphasize three points:

(1) That in regions of endemic goitre the fish may also be affected.

(2) That the thyroid hyperplasias of fish react with iodin exactly as do the thyroid hyperplasias of the higher animals.

(3) That the findings of these changes in fish is perhaps the most direct evidence that goitre may be associated with water.

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REMARKS MADE UPON THE PRESENTATION OF A PORTRAIT OF DR. FERDINAND EDME CHATARD, TO THE MEDICAL AND CHIRURGICAL FACULTY OF MARYLAND, DECEMBER 8, 1909.

By J. Whitridge Williams,
Professor of Obstetrics, Johns Hopkins University.

Ladies and Gentlemen: It is my privilege this evening, on behalf of the Chatard family, to present to the Baltimore City Medical Society, and through it to the Medical and Chirurgical Faculty of Maryland, the portrait of Dr. Ferdinand Edme Chatard, which stands before you. It was painted by Mr. Robert Hinckly, of Washington, and is thought to give an excellent idea of Dr. Chatard's appearance at the age of seventy.

All of us who are familiar with the medical history of Baltimore know how prominent a position he held for more than fifty years of the last century in our city, in which he was extensively engaged as a general practitioner, but more particularly as an obstetrician. It is particularly on account of the latter fact, I suppose, that I was requested to present his portrait to you; and I assure you that I regard the invitation as a peculiar honor, and shall take the greatest pleasure in telling our younger members something of his life work.

Ferdinand Edme Chatard was born in Baltimore, August 3, 1805, in a house on W. Saratoga Street, opposite to where St. Alphonsus Church now stands. His father, Dr. Peter Chatard, a native of San Domingo, settled here in the year 1800, and was extensively engaged in practice up to the time of his retirement in 1845. The younger Chatard was educated in this city and received the degree of A. B. from Mount St. Mary's College in 1824 and of M. D. from the University of Maryland in 1826. He then studied for three years in Europe, chiefly in Paris, where he had ample opportunity to acquire the facility in obstetrical operations which so characterized his later work. After his return to Baltimore in 1829, he practised medicine for fifty-four years until his retirement in 1883, and five years later, October 18, 1888, died suddenly at the age of eighty-three.

He married Miss Eliza A. Marean, a daughter of Silas Marean, Esq., and was survived by three sons and one daughter. The former were Thomas, Silas and F. E. Chatard Jr., all of whom studied medicine. Thomas, however, did not practise; Silas later entered the ministry and is now the Catholic Bishop of Indianapolis; while Ferdinand Jr., practised medicine in this city until the time of his death in 1900. The only surviving daughter, Juliana, is now a Sister of Charity. One of the sons of Ferdinand Jr., is Dr. J. Albert Chatard, the Secretary of the Book and Journal Club, and one of the younger members of the Faculty, who takes great interest in its affairs.

Thus you see, four generations of this family have been continuously engaged in medical practice in this city from the year 1800 to the present time, a period of one hundred and nine years; so that one may well speak of the Chatard medical dynasty, which with one exception, is the longest in Baltimore. Dr. John N. Mackenzie, the laryngologist, is the representative of the latter, having been preceded by his father, John Carrere; his grandfather, John Pinkerton, and his great grandfather, Colin Mackenzie, who began practice in this city in the year 1797. It is interesting to note that the latter was one of the original physicians to the old Baltimore Hospital, which stood on the site now occupied by the Johns Hopkins Hospital.

As far as I know, only four other families in Baltimore claim so long a medical ancestry, namely, the O'Donovans, the Smiths, the Magruders and my own family, although none of them have practised continuously in this city for the entire period. The accomplished Secretary of the Baltimore City Medical Society, Dr. W. E. Magruder, dates his medical ancestry back to his great grandfather Zadock, who graduated in 1786. His ancestors, however, practised in Montgomery County, Md., and the present Dr. Magruder came to Baltimore in 1895. The other three families have a record of three generations of practitioners in this city and an earlier one elsewhere. My grandfather, Dr. John Whitridge, settled here in 1820, Dr. John Henry O'Donovan in 1824, and Dr. Nathan Ryno Smith in 1827. All of them had sons who were, and grandsons who are at present, engaged in practice in Baltimore; and as far as I can ascertain my own medical ancestry is the longest of all, as my great-grandfather, William Whitridge, began practice in Tiverton, R. I., in 1770—one hundred and thirty nine years ago.

After this genealogical digression, I return to Dr. Chatard, who, after returning from Europe, thanks to his father's influence and his own excellent attainments, soon built up a large practice, and for nearly fifty years was the leading obstetrician among the upper classes of this city. During that period he delivered 5268 private patients, and some idea of his activity may be gained from the fact that during the year 1858 he attended 178 obstetrical patients. His father, Dr. Peter Chatard, also had an extensive obstetrical practice, and in 1855, his son-in-law, Dr. W. C. Van Bibber, reported to the Medical and Chirurgical Faculty a summary of 4309 cases which he had attended. Thus, it appears that during the first three-quarters of the last century these two men delivered nearly 9600 patients, which is the largest private obstetrical practice with which I am familiar, being most nearly approached by the experience of Drs. John and T. E. Beatty, of Dublin, who left a record of 7690 cases.

Dr. Chatard lived for many years at the southwest corner of Charles and Lexington Sts., now occupied by O'Neill's dry goods store. The portrait gives some idea of his appearance, and those who knew him say that his most striking personal characteristic was extreme neatness, which applied not only to his person, but to all his dealings in life. I am told at the time when vaccination was practised from crusts he was frequently

the only physician in town who was sufficiently thoughtful and methodical to carry a supply over the summer, so that the following winter he was able to supply his brother practitioners with sufficient virus for their first vaccinations.

He was extremely sympathetic and kindly, and possessed the confidence of his patients in the highest degree. Only last summer I met an elderly lady on the steamer returning from Europe, who had been his patient for many years, and she stated that she could never forget his kindness to her under most trying circumstances. Like most of the practitioners of his generation he attended closely to business and took very little holiday, and from what I can learn it is probable that an enforced absence from the city in 1845, following an epidemic of puerperal fever, was probably his longest vacation. He was a devout Roman Catholic and all of his descendants have remained in the same faith. He was not a writer, and therefore made no contributions to the medical literature of his time, and were it not for the record of his cases which he left, and which was kindly placed at my disposal by his grandson, I should be able to say comparatively little of his work.

As I have already indicated he attended 5268 private patients in labor and recorded and tabulated his observations in 5182 cases; and it is upon his own data that I shall rely to show how excellent an obstetrician he was.

Thus, he noted the presentation and position of the child in 5171 cases, and the percentages given in the following table show that his conclusions were quite comparable to those in the most recent text-books:

Vertex	4,920 cases,	95.14 per cent.
Breech	181 "	3.52 " "
Face	31 "	0.60 " "
Transverse	29 "	0.56 " "
Compound	9 "	0.17 " "

Twins occurred once in 85 labors and triplets were delivered once in the entire series. The greatest average number of births occurred in December and the smallest number in April, and it is interesting to note that his father, Peter, had exactly the same experience. Fifty-two per cent of his children were boys and 48 per cent girls, a proportion of 108 to 100, a very close approach to the results shown by world-wide statistics.

That he was a close and accurate observer is also shown by the results which he obtained by tabulating the time of birth in 4484 cases. This was between 6 a. m. and 6 p. m. in 2256 instances, and between 6 p. m. and 6 a. m. in 2228 instances—50.3 per cent and 49.7 per cent, respectively, a difference of 0.6 per cent in favor of the daylight twelve hours. Such a conclusion is contrary to the general opinion, as it is usually believed that many more labors occur at night; but its correctness is borne out by my own experience, which shows that only two per cent more births were noted in the night than in the day twelve hours.

He made no note concerning the weight of the children, but I imagine that his results were very similar to those of his father, who stated that in his experience only one child had weighed as much as twelve and only five as much as eleven pounds; thus showing that he must have weighed the children accurately instead of attempting to please the parents by guessing at their weight.

On considering his results we find that they were extremely favorable for the period in which he practised, as he lost only thirty-nine mothers from the following causes: Hæmorrhage 3, placenta prævia 4, ruptured uterus 5, eclampsia 8, and infection 19. This corresponds to one death in 133 cases or a mortality of 0.75 per cent, and is a distinct advance upon the normal mortality of 1 to 120 as calculated by Matthews Duncan in his monograph on "The Maternity in Child-bed," published in 1879.

Considering the fact that a large part of Dr. Chatard's practice was in the period prior to the discovery of anæsthesia, one must conclude that he was an accomplished and dexterous operator, and the following table gives an idea of his activity in this regard and shows that he terminated every twelfth labor artificially:

Forceps was employed in	372 cases, or	7.8	per cent.
Version " " "	32 " "	0.61	" "
Vectis " " "	4 " "	0.08	" "
Craniotomy " "	26 " "	0.57	" "
Embryotomy " "	1 " "	0.02	" "
	435 cases, or	8.37	per cent.

It thus appears that he applied forceps once in every 14 cases, which was nearly twice as frequently as in the practice of his father, who employed them once in 30 cases and considered that quite excessive, as is shown by the following quotation: "The use of this instrument might have been reduced to three quarters, but feeling certain of not injuring the children and of being able to abridge the sufferings of the mothers, I did not hesitate to make use of it."

It is interesting to inquire how he came to employ forceps so frequently, as at that time it was contrary to the best French and English usage. This is shown by the fact that it was employed once in 78 cases in 55,000 labors reported from the Maternity of Paris between the years 1848 and 1877, and only once in 131 cases in the practice of the Beattys to which I have already referred. On the other hand, it is evident that he did not fall into the error of Osiander, the great apostle of operative interference in obstetrics, who applied forceps in two out of every five cases. This being the case one can only conclude that he evolved the practice from his own experience, as he had found that the operation was harmless in suitable cases, that it spared the patient unnecessary suffering and also did away with the occurrence of certain complications incident to too great prolongation of the second stage of labor.

It is also interesting to note that his neatness came into play in this operation, as he stated that he always washed his forceps in hot water before using them, and applied them while still warm with the idea that he avoided shock to the patient by so doing. Following the French teaching he evidently employed forceps in preference to version, and seems to have limited the use of the latter almost entirely to the treatment of transverse and compound presentations, as his records show

that he performed version in only 32 instances, while he had to deal with 29 transverse and 9 compound presentations.

He resorted to craniotomy in 26 instances, although all but four of the patients were seen in consultation. The fact that he employed an operation which was contrary to the tenets of his church showed that he was not hampered by superstition and used his best judgment in the treatment of his patients. Moreover, the comparatively frequent employment of this operation, as well as the fact that he recorded five cases of death from rupture of the uterus, indicates that even at that time serious disproportion between the size of the head and the pelvis was not unknown, and tends to cast doubt upon the belief that the occurrence of contracted pelves is altogether of recent development.

Dr. Chatard's records concerning the complications of labor present several points of interest. In the first place, he recorded 44 cases of eclampsia with 8 deaths, a mortality of 18 per cent, which is practically as good as that obtained at the present time. No doubt the fact that he practised during a period when venesection was liberally employed contributed greatly to his comparatively excellent results. On the other hand he stated that hæmorrhage occurred in 145 and adherent placenta in 115 cases, a percentage of 2.8 and 2.2, respectively. Such figures are far too high and clearly illustrate the disadvantages under which our predecessors labored, prior to the introduction of modern and more rational methods of conducting the third stage of labor.

He did not believe in the dilating action of the bag of waters, which he believed could be ruptured at any time with impunity. He also held that perineal tears were more often due to the action of the shoulders than to the distension produced by the head; for this reason he strongly urged that the child should not be extracted immediately after the birth of its head, but that its expulsion be left to the unaided efforts of nature.

When I first began the practice of medicine, I frequently heard physicians recommend Chatard's "scattering plaster" in the treatment of engorged or inflamed breasts. Whether this was an invention of the subject of this sketch or of his father, Dr. Peter Chatard, I am unable to say, but in any event it was a widely employed remedy for many years, and Hynson and Westcott tell me that they still keep it in stock, and that even now it is occasionally called for. It consists of galbanum, yellow wax, and olive and linseed oils, and no doubt acts as well as most other remedies; although my own experience leads me to believe that the results obtained were probably purely imaginary, as in such cases the breasts do much better when left absolutely alone than when subjected to treatment of any character whatever.

Possibly the most interesting portion of Dr. Chatard's records is that dealing with puerperal infection, of which he observed 27 cases with 19 deaths, that is one death in every 277 labors or 0.38 per cent. Considering that he practised in the preantiseptic period, such results are excellent and compare more than favorably with the figures of 1 to 212 which LeFort and Husson calculated as the normal incidence in private practice. At the time Dr. Chatard was actively engaged in practice, puerperal fever was the scourge of lying-in institutions, and some idea of its ravages may be gained from the statement that the average mortality in the Maternity of Paris from the years 1802 to 1864 was 5.6 per cent. At certain times it was much higher, and LeFort has stated that it reached 32½ per cent in February and 58 per cent in December, 1864, at a time when something more than 200 women were delivered each month.

Dr. Chatard studied this disease in great detail, and left a separate record giving the history of all his patients who suffered from it, in which it is interesting to note the names of women connected with several of our most prominent old families. He also tabulated the results in the patients treated or delivered immediately before and after the occurrence of this disorder, and, except in the year 1845, discovered nothing which seemed to indicate that the disease might be conveyed from one patient to another. Ordinarily the cases occurred sporadically at intervals of several years, and none were noted after 1871, although two cases occurred in 1844, three in 1848 and two in 1857, but each of them were separated from the others by an interval of at least several months.

In 1845, however, the year made memorable by the appearance of Semmelweiss in the Lying-in-Hospital in Vienna, he had ten cases of puerperal fever. One occurred in February and another in May, but in the period extending from October 7 to December 11, he delivered 25 women, eight of whom developed puerperal fever and six died. Three of these cases were consecutive, while the remainder were interspersed between normal cases. Even this experience, however, did not convince him of its infectious character and shows how difficult it was for our predecessors to comprehend its true nature. After this epidemic he left town for an extended vacation, though I imagine it was more to allay the fears of his patients than to rid himself of any supposed contagion; for at the end of his tabulation he stated "During my long practice of medicine, while attending cases of small-pox or its various modifications, scarlatina, typhoid and typhus fever and puerperal fever, I have taken no particular precaution except to keep my hands clean and washing them frequently, and particularly before attending obstetrical cases. This for the purpose of avoiding innoculation which might otherwise occur, my personal experience leading me to the conslusion that diseases are not carried by the dress or person of a physician."

His son, Dr. F. E. Chatard, utilized this material in an address before the Baltimore Gynecological and Obstetrical Society on the "Communicability of Puerperal Fever," which appeared in the *Maryland Medical Journal*, 1888, XVIII, 467-470, in which he concluded that antiseptic precautions were unnecessary and it is interesting to note that many who took part in the discussion held similar views.

What a contrast to the present time when everyone knows that practically all serious cases of puerperal infection are due to the streptococcus and can be prevented by the employment of strict aseptic technique. It is hardly necessary to refer to

the results now obtained, but the change in hospital results is almost miraculous, and Pinard reports a septic mortality of 0.15 per cent in 45,633 cases delivered in the Baudelocque clinic during the eighteen years ending with 1909, and Mermann of Mannheim one of 0.08 per cent.

With this exception it is apparent that Dr. Chatard's obstetrical work was well in advance of his time and gave results of which anyone might be proud, and I regard it as a great privilege to be able to bring the facts before you.[1]

[1] Dr. J. Albert Chatard has recently presented to the library of the Johns Hopkins Hospital a valuable collection of medical books which belonged to his father and grandfather. Among these are some rare works so that the gift is one of the most important acquisitions that the library has received.—EDITOR.

ON THE CUTANEOUS DISTRIBUTION OF THE SUPERFICIAL RAMUS OF THE RADIAL NERVE AND ITS COMPENSATORY EXTENSION.

By IRVING HARDESTY,
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Total absence of function of the branches of two of the three nerves distributed to the lower forearm and hand produced with destruction of the tendons of the forearm, but leaving the hand intact, seems of comparatively rare occurrence. More than a year ago Dr. Harry M. Sherman, of the Department of Surgery of the University of California, submitted to me a patient of his who had suffered an injury of the ulnar side of the forearm, resulting in the destruction of both the ulnar and median nerves, and later he kindly allowed me numerous opportunities to examine the case. The study resulted in a few observations which may be of general interest. These observations include (1) corroboration of the position and extent of the cutaneous area of the hand and wrist supplied by the radial nerve; (2) proof of the retardation of growth and regeneration by scar tissue; (3) retardation of growth of peripheral nerve fibers by impaired nutrition of the tissues to be innervated, and (4) the tendency on the part of the intact nerve toward a compensatory extension of its area into domains not originally occupied by it, but which have lost their usual innervation.

SURGICAL HISTORY OF THE CASE.

Dr. Sherman supplied the following history of the case:

F. L., æt. 50 yrs., a miner.

In August, 1905, he had his left forearm caught between cogwheels and suffered a severe crush with fracture of the ulna and laceration of the flexor tendons on the middle and ulnar side of the forearm. Both the median and the ulnar nerves were severed and implicated in the slough.

Healing left a sound ulnar bone with a scar, depressing the skin surface and attached to the bone, occupying the middle and ulnar regions of the lower half of the forearm.

Patient was unable to use the flexor muscles of the forearm except the radial flexors of the carpus. He had slight control over the thumb. There was no sensation in the fingers except the radial side of the index finger. There was sensation in the thumb. The palm of the hand had sensation external to a line drawn between the first and second metacarpal bones. There was no sensation on the ulnar side of the forearm. On the back of the hand the anesthesia and the sensation corresponded to the ulna and radial nerve distributions respectively.

An attempt was made to unite the median nerve to the radial by reflecting a flap from the side of the median and carrying it over to and inserting it into the radial. In doing this the integrity of the radial was very carefully preserved, for the result of the procedure was so problematic that it seemed unwise to jeopardize the radial conductivity. At the same time the contact was adequately made. An attempt was made to reunite the severed tendons. This was found impracticable because of the union of the scar to the ulna, so the scar was dissected out and a flap of skin was turned up from the chest, the arm brought up to it and the flap sutured to the forearm. When it had united, the flap and the arm were detached from the chest. At a later date and after all wounds in the forearm had healed, a silk tendon was put into the flexor muscles of the forearm and carried underneath the flap and stitched to the cut tendons just below the wrist. It was found impracticable to isolate individual muscles and individual tendons and so a common flexor tendon for all of the fingers was arranged for. This process took a long while and when all of the wounds had healed, the man had recovered flexion of his wrist, but had not individual flexion of the fingers or flexion of the fingers collectively. There was no evidence that any function was permitted by the union between the median and the radial nerves.

When Dr. Sherman submitted the patient to me, more than two years had elapsed since the accident resulting in the injury, and my first examination was made about nine months after the last operation, the grafting on of the skin flap from the chest, had been performed. The wound had completely healed, but the skin and general condition of the hand yet indicated considerable impairment of the blood supply due, in part, to incomplete restoration of the supply destroyed in the wound, and in part to loss of nervous vascular control.

As seen in the history, the original injury, produced by the crushing and tearing of the forearm by the cogwheels, was so serious as to produce far more complicated disturbances than result from simple accidental severing of the ulnar and median nerves. Not only the nerves but the flexor tendons and portions of the muscles of the ulnar side and the median or front side of the forearm were lacerated by the cogs. In addition, there was the considerable sloughing accompanying the first healing and the formation of a large amount of scar tissue which involved the frayed ends of the nerves and tendons, and which made it necessary for Dr. Sherman to remove the scar tissue and graft on a flap of skin from the chest. This necessity resulted in further confusion due to the actual loss of original tissue and to the transplanting of strange skin in the area affected.

Thus, the general symptoms were more extensive than are

described as resulting from section of the nerves alone. The characteristic claw-hand had developed, as was to be expected from loss of the ulnar and median nerves, but, due to destruction of the flexor tendons, the metacarpals and first phalanges of all the digits showed more over-extension than usually described from injury to either or both of the nerves alone, and the second and third phalanges seemed less flexed. There was but a slight ability to control the thumb. Its terminal phalanx could be imperfectly flexed and extended, and the thumb could be slightly adducted, but its metacarpus and first phalanx maintained a general position of extension and abduction. There was a total inability to spread out the remaining digits or to further flex and extend them, and the power of pronation was lost.

Owing to the confusion resulting from the destruction of the tendons and injury to the muscles and the very imperfect muscular activity possible even in the event of complete restoration of the nerve supply to the muscles, all attempts to determine evidences of growth and regeneration of nerve fibers to the muscles were discarded. It was decided to confine attention solely to cutaneous distribution proper. Sensations manifest in the tela subcutanea and fascia appeared too vague and indefinite along the margins of the anesthetic areas to be satisfactorily located and delineated.

The ordinary method for determining the extent of cutaneous sensations was pursued in the following way:

At intervals varying from two weeks to two months the patient was taken into a quiet and warm room, his arm bared to the elbow and extended on a small work-table and upon a cushion of warm towels, and covered with warm towels. Owing to the impaired circulation of the hand and forearm it was deemed of prime importance that, throughout each period of examination, the skin be maintained as uniformly as possible at or slightly above normal blood temperature. Especial care was taken that the patient's position, seated at the table, was as comfortable as possible. The patient was then blindfolded. An esthesiometer of the model devised by Max von Frey was used for all the studies, with the bristle extended 7 mm. Beginning well within the known anesthetic area, the skin was pricked vertically at intervals of 2 to 3 mm. in a line toward the area known to be sensitive. The pressure exerted in pricking the skin was controlled by continuing it in each instance till the bristle just began to bend, and then suddenly removing it. The patient was directed to indicate by the word "yes" his first perception of cutaneous sensation, and the prickings were made about 2 seconds apart to give time for discrimination. Upon the sign "yes" being given, an assistant, who likewise watched the point of the bristle, made a small dot of India ink upon the spot stimulated, using a fine-pointed camel's-hair brush. The lines of prickings, passing from the anesthetic toward esthetic regions, were made from 5 to 10 mm. apart, depending upon the locality. Whenever there was doubt as to the point at which sensation began, a line of prickings was repeated. When the ink dots were made at sufficiently frequent intervals, indicating points in the margin of the sensitive area, the dots were carefully joined into a solid line with the brush point carrying India ink. Thus a continuous black line was obtained defining the boundary between the areas.

The hand and forearm were next photographed in three or four positions. The dorsal and palmar surfaces and the ulnar aspect were always taken, and sometimes both the radial and ulnar aspects. Attempt was made to make all the photographs to scale. Tracings were made from these photographs of the hand and forearm, and the ink line upon them, which latter always came out sharply. Figs. 1 to 5 are reproductions of 12 of these tracings, with the sensitive area filled in with stippling.

The fact is appreciated that determinations of the boundaries of sensitive cutaneous areas are usually untrustworthy as to accuracy, due to the vagueness of the sensations along the border line, and especially to the varying mental equations of both the patient and the operator. Every precaution was taken to guard as much as possible against inaccuracies. The hand and forearm were kept warmed during each examination; the examinations were made under similar conditions of quiet and room temperature. To guard against errors arising from fatigue, the blinder was removed at intervals of about 15 minutes and the patient was induced to turn his attention to other things. During these intervals, the warm towels, upon which the arm and hand had rested and with which they were partly covered, were renewed. Fortunately, the patient was a man of remarkably unexcitable disposition and understood very little of the object of the investigation. His attention was confined to giving the sign as directed, and only upon perception of positive pricking sensations from the skin. Sensations of pressure by the bristle were often mentioned, but disregarded as subcutaneous rather than cutaneous.

Owing to the well-known fact, noted by Tillmans,[1] Thorburn and Williamson,[2] and others, that adjacent territories of nerves overlap each other through the interextension of the collateral and terminal twigs of the nerves, it is realized that the territories of different nerves rarely appear sharply defined. In this case, however, all the nerve twigs for the skin of the hand were totally destroyed except the twigs of the intact superficial ramus of the radial nerve, and thus all sensations manifested on the hand, at least, could be interpreted as mediated through this nerve alone, and the boundary established on the hand could be considered the boundary of the area of this nerve. As indicated below, the nerves supplying the sensitive areas on the wrist and forearm, joining the area of the radial, could be quite approximately determined because their terminal twigs also had been practically isolated in the original destruction of tissue and by the grafting on of the flap of strange skin.

Considering the conditions always to be met in investigations of this kind, the boundary lines obtained in the frequent examinations were remarkably constant and the varia-

[1] Tillmans: Archiv für Klinische Chirurgie, 1882, Bd. 27, p. 1.

[2] Thorburn and Williamson: Encyclopedia Medica, 1901, Vol. 8, p. 282.

Oct. 30, '07.
Fig. 1A.

Nov. 26, '07.
Fig. 2A.

Jan. 26, '08.
Fig. 3A.

Fig. 3C.

March 30, '08.
Fig. 4A.

Oct. 6, '08.
Fig. 5A.

Fig. 1B.

Fig. 2B.

Fig. 3B.

Fig. 4C.

Fig. 4B.

Fig. 5B.

tions manifestly indicating changes in innervation are considered quite trustworthy.

In the tracings of the photographs here given, the boundary lines with the variations due to changes in the innervated area do not appear throughout in their exactly true relative positions, due to the fact that the given positions of the hand, with reference to the camera, were not always exactly identical. The varying amounts of foreshortening, because of the slightly varying positions of the hand, have resulted to greater disadvantage in the tracings than showed in the photographs where the effects of shadow and perspective were present. Attempts were made to photograph in identical positions throughout, and the slight effects due to variations in the angles of exposure were not realized till the tracings were made and compared, which was after all the photographs had been taken. These effects, however, do not seriously obscure the few points of interest. The effect is most marked in comparing Fig. 2a with Fig. 3a. In Fig. 3a the ulnar side of the hand was turned outward, toward the camera, more than in Fig. 2a, in which the dorsum was squarely exposed.

The common or average areas of cutaneous distribution upon the hand and wrist of the ulnar, median and radial nerves are sufficiently familiar to all, so their description here is unnecessary. The usual territory supplied by each has been repeatedly determined by dissection, experimental stimulation after section, and by study after degeneration following accidental division or destruction of the nerves. The literature of the past 50 years abounds with descriptions of cases, most of them detached and more or less crude, but which, taken together, have rendered it possible to outline the normal or usual areas of distribution of each of the nerves. Likewise there are abundant papers and notes describing instances of abnormal distribution of these nerves. Kennedy[3] was the first to give a complete and systematic summary of the literature upon the regeneration of sectioned nerves, and to draw general conclusions as to areas of distribution upon the limbs based upon information assembled from numerous cases. Including that collected by Cruikshank, he gives a bibliography extending backward as far as 1537. Sherren,[4] in two lectures, sums up previous findings and opinions as to the areas supplied by the nerves to the limbs, combined with

Fig. 6.

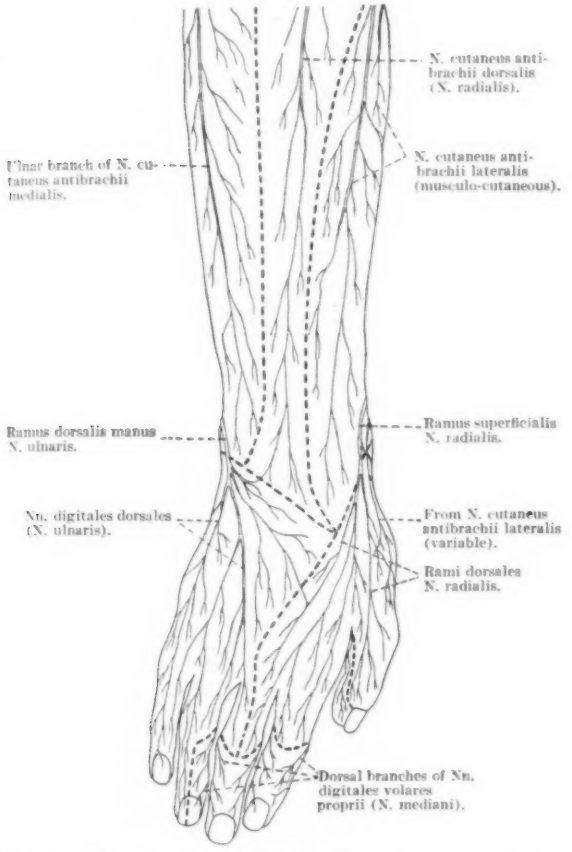
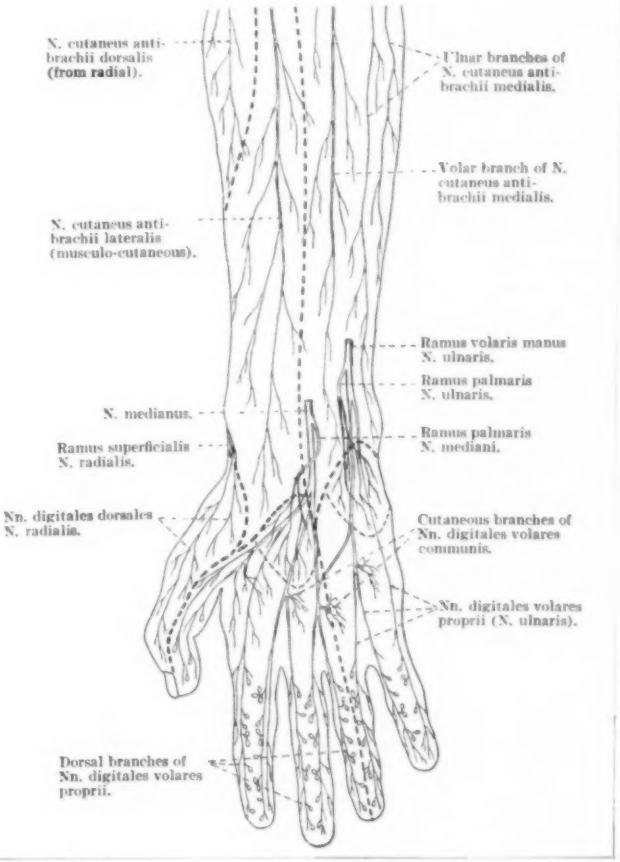

N. cutaneus antibrachii dorsalis (N. radialis).
Ulnar branch of N. cutaneus antibrachii medialis.
N. cutaneus antibrachii lateralis (musculo-cutaneous).
Ramus dorsalis manus N. ulnaris.
Ramus superficialis N. radialis.
Nn. digitales dorsales (N. ulnaris).
From N. cutaneus antibrachii lateralis (variable).
Rami dorsales N. radialis.
Dorsal branches of Nn. digitales volares proprii (N. mediani).

Fig. 7.


N. cutaneus antibrachii dorsalis (from radial).
Ulnar branches of N. cutaneus antibrachii medialis.
Volar branch of N. cutaneus antibrachii medialis.
N. cutaneus antibrachii lateralis (musculo-cutaneous).
Ramus volaris manus N. ulnaris.
Ramus palmaris N. ulnaris.
N. medianus.
Ramus palmaris N. mediani.
Ramus superficialis N. radialis.
Nn. digitales dorsales N. radialis.
Cutaneous branches of Nn. digitales volares communis.
Nn. digitales volares proprii (N. ulnaris).
Dorsal branches of Nn. digitales volares proprii.

[3] Kennedy, R.: Phil. Trans. Royal Soc., Vol. 188, 1897, p. 257.

[4] Sherren, J.: Lancet, 1906, Vol. I, p. 727.

results obtained by himself from personal study of 175 cases of nerve injury. Tonkoff[5] gives one of the collections of descriptions of abnormal arrangements of the cutaneous nerves to the back of the hand, comparing and explaining them on the basis of the normal arrangement of the same nerves in the apes.

For ready reference in connection with the case here in hand, Figs. 6 and 7 are given. These are compiled from various findings and similar diagrams in text-books of anatomy, and are considered as showing the average or usual cutaneous areas of the forearm and hand supplied by the respective nerves as indicated.

Several cases are recorded in which the ulnar and median nerves were severed. These may be divided into those in which the nerves were clean cut (glass cuts, knife wounds and all strictly localized injuries), and those in which the nerves were lacerated, accompanied by the destruction of considerable other tissue, as in the case here described. Sherren (loc. cit.) makes a distinction between subcutaneous sensations, "deep sensibility" or "deep touch," and direct cutaneous sensibility, "light touch," and states that "deep sensibility" is not present when the tendons of the extremity are destroyed or even severed. He bases this conclusion upon the study of cases in which the cutaneous nerve branches are destroyed both with and without accompanying destruction of the tendons beneath. This probably means only a serious impairment of the subcutaneous sensations due to the severing of the nerves and the degeneration of the plexuses which accompany the tendons, many of whose fibers terminate upon the tendon sheaths and bones and in the muscles. In addition, a few of the sensory fibers ending in the subcutaneous connective tissue may not be severed with the division of the tendons, and there should remain, with severed tendons, a certain amount of deep sensibility dependent upon the cutaneous nerves proper.

In the case here in hand, a considerable extent of the flexor tendons had been totally destroyed, but there was occasionally noted along the inner margins of the anesthetic area indications of deep sensibility under skin having no direct cutaneous sensibility. These were more frequently remarked during the latter part of the study, when regeneration of the cutaneous nerves had become a little more rapid. They are mentioned as indicating that the growing nerve twigs extend in the loose subcutaneous tissue in advance of the region in which they are actually terminating in the skin proper.

In the absence of the cutaneous supply to the hand from the ulnar and median nerves, the distribution of the radial (the only sensitive area remaining upon the hand) appeared to conform quite closely to the average or normal distribution of this nerve. On the dorsum of the hand, the area extended slightly upon the ulnar side of the first phalanx of the middle finger (Fig. 1a) instead of to the mid-line of this phalanx, and thence curved toward the ulnar side of the dorsum rather than toward the radial side, as does the average or normal area (Fig. 6). However, judging from the subsequent studies, this apparent abnormality of the area is considered as probably due in part to the compensatory extension of twigs from the radial already begun during the time between the injury and the time the first study (Fig. 1) was made, and partly, from above, to the terminal twigs of the lateral cutaneous antibrachial nerve.

On the palmar aspect, the boundary line of the sensitive area was normal for the radial supply to the thumb, extending toward the volar surface to a line beginning at the lateral margins of the nail and passing thence parallel to its first and second phalanges (Fig. 1b). Thence, instead of curving radialward to terminate the area just above the radial edge of the wrist joint (Fig. 7), the boundary line turned medianward to include the greater part of the thenar eminence, and then upward upon the forearm to the line of suture of the skin flap grafted upon the forearm. This course is due to the fact that the cutaneous area of the radial nerve is joined on the thenar eminence by the area supplied by the lower end of the volar branch of the lateral cutaneous antibrachial (musculo-cutaneous) nerve, a part of which area here comprised the only isthmus of sensitive skin connecting the unaltered skin of the forearm, above the grafted area, with the hand (Fig. 3c).

The flap of the skin from the chest, grafted onto the forearm after removing the large amount of cicatricial tissue resulting from the original wound, was finally detached from the chest wall on January 28, 1907, and the final stitching into the forearm made. Thus it was during the month of February, 1907, that the usual sloughing and healing processes were completed, and it was not until the latter part of the October following that the patient was first subjected to the study described here.

Notwithstanding this length of intervening period, the first study with the esthesiometer revealed practically no invasion of cutaneous nerve fibers into the grafted area. Almost throughout its entire boundary the line of suture of the graft, which could be distinguished as a line of scar in the skin, was likewise the line of demarkation here between the sensitive and anesthetic surfaces. Much of the grafted area itself still had the characteristic smooth, glistening appearance, but with a color showing a better vascular supply than had the suture line.

Beginning with the bristle within the grafted area and working toward the suture line, no sensation was manifest during the first study till the suture line was crossed. Then, suddenly, on the immediate sensitive side of the suture line, not only sensation was manifest but hyperesthesia and often of considerable amount. The patient would suddenly cringe, uttering a loud "yes." This is considered as indicating that the cutaneous nerve twigs, severed by the injury and operation, spreading in the corium toward the grafted area, and terminating in the stratum papillare and epidermis, had been resisted by the density of the scar tissue along the suture line. The obstruction had caused the growing ends to be reflected

[5] Tonkoff, W.: Internat. Monatschrift für Physiol., Bd. 15, 1898, p. 156.

and become coiled up along the sensitive side of the scar line, giving the skin immediate to the line an especially abundant innervation. In Figs. 1a and 1b the boundary shown of the anesthetic area of the forearm is coincident practically throughout with the line of suture of the grafted area.

In subsequent studies, when the tests showed that in places the growing nerve fibers were succeeding in breaking through the line of sutural scar tissue (Figs. 2a and 2b), the boundary of the anesthetic area became more and more irregular. And it is interesting to note that wherever along the line sensation invaded the anesthetic area by passing through the scar line, the line of hyperesthesia disappeared. Painfully sensitive before breaking through the scar, the line became normally sensitive afterward.

The obstructive effect of scar tissue against the extension of regenerating and growing nerve fibers is of common experience, especially as formed in the region of division of nerve trunks. Among others noting the effect, Holmes[6] reports a case of operation six months after the radial nerve had been severed, in which the end of the central stump was found involved in a dense knob of connective tissue. This knob had totally obstructed growth extension, and in it the regenerating fibers were coiled and gnarled, increasing its density.

One might expect that the anesthetic area of the forearm, represented by the area of the grafted skin-flap, would acquire its innervation, beginning along its upper border and gradually spreading from this border downward toward the hand. This would seem the natural direction of procedure from the fact the severed nerves which normally supply the lower part of the forearm are the terminal and downward-extending ends of the ulnar and volar branches of the medial cutaneous antibrachial nerve (internal cutaneous nerve), the lower cutaneous arm branch of the radial or musculospiral (N. cutaneus antibrachii dorsalis), and the terminal portions of the volar and posterior branches of the lateral cutaneous antibrachial nerve (cutaneous portion of the musculo-cutaneous nerve). The arrangement of these is indicated in Figs. 6 and 7. A wholly downward spread of the regaining innervation, however, was by no means the case. The spread of cutaneous sensibility from the original boundary into the anesthetic area was about as rapid from the sides and even from below as it was from above. The spread from below, because of the locality of the injury and the position of the grafted flap, was of necessity from the radial side, and is explained as due to the growth of lateral twigs from a probably uninjured terminal cutaneous branch of the musculocutaneous nerve and, further, to the growth of lateral twigs from the superficial branch of the radial (radial nerve of the older nomenclature). From the general downward normal direction of the twigs of the superficial branch of the radial, such lateral twigs from it into an area not previously supplied by it would indicate a tendency toward compensatory innervation on the part of the radial.

Compensatory extension of the area of the hand normally, and here originally, supplied by the radial was quite positively indicated. The first examination of the patient showed that the area of the hand supplied by the superficial branch of the radial corresponded quite closely to that usually given as the normal area of the radial (Figs. 1a and 1b). Though nine months had elapsed since the grafting of the skin and about two years since the original injury, so great had been the impairment of nutritive functions by the laceration and growth of scar tissue that at the first examination but little evidence was manifest of innervation advancing into the area rendered anesthetic. On the dorsum of the hand and wrist (Fig. 1a), the sensitive area extended further toward the ulnar side than does the usual area supplied by the dorsal branches of the radial (Fig. 6). This is explained above as due in part to the downward extension of the terminal twigs of the lateral antibrachial cutaneous (musculo-cutaneous) nerve, which was probably uninjured by the accident and operation, and in part either to a larger dorsal area than usual supplied by the radial, or to an already begun compensatory extension of twigs from the dorsal branches of the superficial branch of the radial to the skin of the wrist and dorsum of the hand. It has been noted that the skin of the dorsum of the hand is not always supplied by the ulnar and superficial branch of the radial alone. Zander[7] called attention to the fact that twigs from the lateral cutaneous antibrachial (musculo-cutaneous) and the dorsal cutaneous antibrachial nerve (external cutaneous branch of the radial) may take part. The latter branch was involved in the injury and its area involved in the skin graft, so that it was not represented at all in the dorsum of the hand. The former nerve, however, was no doubt represented, and very probably took part in the upper part of the extension of the sensitive area.

The cutaneous supply over the dorsal surface of the first phalanx of the third or middle finger and the adjoining end of the third metacarpal was practically that usually given for the radial nerve, i. e., sensation was present over only the radial half of the first phalanx and the line curved slightly ulnarwards over the third metacarpal.

The radial supply to the skin of the thumb, at the time of this first examination, was likewise that usually described. Normal sensation was present over the dorsal or outer surface of the thumb, but only over the root of the nail (the skin forming the vallum unguis). Along the lateral aspects of the thumb the sensitive area was sharply bounded by lines continuous with the lateral margins of the nail. On the mesial side this line curved slightly from the margin of the nail toward the volar surface and then became straight along the side of the thumb. The line on the lateral side was quite straight on the extended thumb, parallel to and continuous with the lateral margin of the nail, till, reaching the palmar surface covering the first metacarpal, it curved mesially to include the greater part of the thenar eminence. Thence it did not follow the margin of the usual radial area by curving lat-

[6] Holmes, T.: Lancet, 1883, Vol. I, p. 1034.

[7] Zander: Berliner klinische Wochenschrift, 1890, No. 8.

erally to the radial margin of the wrist. This was obviously because of the fact that the sensitive area of the radial was joined on the thenar eminence with the area supplied by the terminal of the volar branch of the lateral cutaneous antibrachial nerve (Fig. 7).

From Fig. 1 to Fig. 5, a and b, the tendency toward compensatory extension manifested by the radial nerve during the months under observation may be seen. A study made between those represented by Figs. 1 and 2 showed a beginning extension of the area of the radial on both the mesial and lateral sides of the thumb and toward the volar surface of the index finger. However, the portion of the sensitive area first to reach the actual palmar surface extended from the dorsal aspect in between the index and middle fingers instead of passing around the lateral aspect of the first phalanx of the index finger. In Fig. 2b this had fused with the extension around the index finger and second metacarpal. Two months later (Fig. 3b) the entire thumb was normally sensitive, and the new palmar area had extended slightly. Thence the compensatory extension continued, though remarkably slowly, both on the palmar surface of the hand and outward on the dorsal aspect of the three fingers and hand, as shown in the figures. The remarkably slow extension was probably due to two causes: (1) the impaired vascular supply to the hand and, therefore, the impaired nutrition, and (2) to the fact that the extending nerve fibers had to penetrate absolutely new and, to them, strange territory, being neither nourished nor guided along paths of least resistance by the terminal stumps of degenerating fibers. Further, it is probable that the fibers so extending were not only slow but were few at the time. Ingbert[5] has computed that in the cutaneous innervation of man, one fiber in an arm nerve supplies an average of 1.3 sq. mm. of skin. Thus comparatively few fibers may have been taking part in the compensatory extension.

[5] Ingbert, Charles: Jour. Comp. Neurology and Psychology, Vol. 13, 1903, p. 209.

As mentioned in the history of the case, Dr. Sherman made an attempt to unite the stump of the median nerve to the trunk of the radial, but taking especial care not to injure the radial. There is a remote possibility that the extension of the hand area of the radial may have been accomplished by fibers grown onto the radial from the median nerve. This is very improbable, however, for the median nerve could have been, with safety, scarcely more than inserted into the sheath or epineurium of the radial, and the density of this sheath would offer greater obstruction to the fragile regenerating ends of the median nerve fibers than would the much looser areolar fascia about it. Further, the distance these fibers would have to extend, compared with the rate at which regeneration was taking place in the other localities of the forearm, and the probable total absence of the guiding influence of degeneration in the radial render very doubtful the presence of median nerve fibers in the terminal twigs of the superficial branch of the radial.

After having the patient under observation for about a year, he was allowed to go unmolested further and, expressing an intention to return to the mining region whence he came, he was lost sight of.

DESCRIPTION OF FIGURES.

Figs. 1a to 5b.—Tracings made from a series of photographs taken of the injured forearm and hand at the intervals indicated during one year. The boundary between sensitive and non-sensitive areas was in each case indicated on the hand, and in the photographs, by a line of ink, not shown in the tracings. Instead, the sensitive areas are stippled to the position of the line, leaving the non-sensitive areas blank. In each figure, a and b are respectively the dorsal and volar surfaces as photographed after the same study. Fig. 3c shows the radial aspect at the same period as Figs. 3a and 3b, and Fig. 4c shows the ulnar aspect at the same period as Figs. 4a and 4b.

Figs. 6 and 7.—Diagrams considered as showing the more common cutaneous areas of the dorsal and volar surfaces of the forearm and hand supplied by the nerves indicated. The overlapping of the areas is intentionally omitted.

PRIMARY UNION AFTER MASTOIDECTOMY.[1]

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One may well be excused for a feeling of diffidence in appearing before such an august assemblage as this International Congress of Otologists to call attention to a mere detail in the performance of a thoroughly well-established surgical procedure. The modern operation of mastoidectomy, for the cure of acute purulent disease of the cellular mastoid portion of the temporal bone, has been developed to such a state of perfection and, as generally performed by well-trained operators, is giving such satisfactory results that it would seem well-nigh impossible to improve upon it. A glance at the history of the development of this operation, however, shows that its steady growth has been a matter of slow progression and that the present degree of excellence has been attained only through the accumulation of many minor improvements suggested from time to time. It may not be too much to hope then that a still nearer approach to perfection may yet be accomplished and it is with the desire to contribute, if only in a small way, to the further development and perfection of this operation that I dare submit for your consideration this contribution to the subject.

[1] Read at the Eighth International Congress of Otology, held at Budapest, September 2, 1909.

A perfect mastoidectomy, or the ideal operation for the cure of mastoiditis, would seem to comprehend complete eradication of the infection and healing of the operation wound in the shortest possible time; secondarily, it goes without saying, these results should be obtained with the least risk to the life of the patient, with the least discomfort to him while under treatment and with due regard to leaving the smallest possible deformity. The first, and perhaps the most important, part of the operation has been well provided for and to that we need devote no further attention in this paper; in every operation for mastoiditis the surgeon now endeavors to remove every particle of pus, detritus and necrotic or carious bone, even though he be compelled to obliterate the cellular structure of the mastoid tip, the zygomatic process and the occipital region, or to invade the cranial cavity itself. Assuming that this has been accomplished, does it constitute a complete operation?

It is rather to the second portion of the statement regarding idealism that I would respectfully direct your attention—namely to the healing of the operation wound in the briefest possible time. With the majority of operators at the present time it is the custom to treat the mastoidectomy wound as a pus cavity that should be compelled to fill up by granulation from the bottom; the process commonly known as secondary healing. To this end the wound is dressed with sterile or antiseptic gauze at the close of the operations and the dressings are changed repeatedly, at intervals of one to three days, until complete closure takes place—a period of time varying from three weeks to as many months. Removal and replacement of these dressings is often decidedly painful to the patient, always time-consuming and more or less annoying for the surgeon, the period of convalescence is generally a protracted one and the remaining scar is not infrequently a source of much concern to the patient. That these are serious defects in the operation as at present generally performed cannot be denied and, quite as certainly, any improvement looking to the procurement of immediate healing of the wound cavity would confer a benefit upon patient and operator alike. Abolition of after dressings, shortening of the period of convalescence and limitation of the scar or of deformity are certainly desirable improvements and there would seem to be no way to attain these save through the immediate healing of the wound.

For the sake of emphasis, we may repeat the special advantages attending or following primary union of the mastoid wound. In the first place, primary union means that the patient is enabled to leave the hospital at the end of one week; healing of the wound edges is usually fairly firm by the fifth day. This is to be compared with the average period of one month required for healing under granulation by the open method. Secondly, the only after dressing consists in an application of a protective pad or a light collodion dressing for a few days to prevent accidental injury; this instead of the repeated cleansing and packing which an open granulating wound requires and which is always uncomfortable for the patient and troublesome to the surgeon or his assistants. Thirdly, primary union means almost no scar; merely a white line, which three months from the date of operation can be seen only when searched for, as against a broader, thicker band of scar tissue with more or less depression, near its center, according to the rapidity with which the new tissue has been formed.

Admitting the desirability of primary union after mastoidectomy, there are several important questions to be considered, bearing upon the method of procedure and the possibilities of success, that might be discussed, seriatim, under the following headings:

1. A brief history of the efforts made in this direction.
2. Criticisms of such attempts, based upon the fear of additional risk to the patient.
3. Scientific investigation in support of the belief that healing under blood-clot is safe and promising.
4. The clinical evidence as to the possibility and probability of success.
5. The technic which gives the greatest assurance of securing primary healing of the mastoid wound.

1. Historical Sketch of the "Blood-Clot" Dressing.

In 1886 M. Schede published a most remarkable report on his experiences with the healing of wounds under the moist blood scab, his paper appearing in the Verhandlungen der Deutschen Gesellschaft fuer Chirurgie, under the title, "Ueber die Heilung von Wunden unter den feuchten Blutschorf." The timeliness of this contribution and its value in general surgery has been well described in a paper by Professor Halsted, who says, "It was my practice for several years to attempt with the utmost care to obliterate the dead spaces in wounds. The results were gratifying, but the technic was often very tedious. For example, after an amputation of the thigh it would not infrequently take an hour to obliterate all the dead space. The mechanical problems were sometimes quite difficult, and one was perpetually annoyed by the fear that he might strangulate the tissues included in the sutures. After a time I became convinced that it was impossible to obliterate thoroughly all the dead spaces in some wounds, and I observed that wounds in which the dead spaces were not obliterated healed throughout by first intention just as regularly as did the other wounds. I was, therefore, quite prepared to welcome Schede's article on the healing of wounds under the moist blood scab. This contribution by Schede I believe to be the greatest which has been made to the technic of surgery since the introduction of antiseptic methods by Lister."

Now, Schede's work proved not only that there was no danger in leaving blood to clot in clean wound cavities but that in obliterating dead spaces the clot favored rapid healing. It was really nature's plan of avoiding or preventing dead spaces, the then bugaboo of the surgeon, and Schede had recognized the fact. In accordance with his own observations and accepting Schede's suggestions, Halsted applied this method extensively and in 1891 presented his report on "The Treatment of Wounds, with Especial Reference to the Value of Blood-clot in the Management of Dead Space" (Johns Hopkins Hospital Reports, 1891, Vol. III, No. 5, pp. 255-261).

Perhaps the most interesting part of that report, to otologists, is the employment of the method in the treatment of osteomyelitis, since he was there dealing with cavities in bone tissues. The most excellent results obtained by Halsted and his associates in the surgical treatment of this affection were remarkable. He found that the protracted after-treatment of these surgical cases could be avoided and primary healing secured in very many instances; the requisite to success apparently being a thorough removal of the diseased bone and all infective material, with disinfection of the wound cavity before allowing it to fill with blood and closing up.

At about the same time that Professor Halsted was conducting his experiments in the application of the blood-clot dressing to the healing of the wounds in long bones, our esteemed fellow worker in otology, Dr. C. J. Blake, of Boston, was adapting it to mastoid surgery. His first public reference to this work appears in the Transactions of the American Otological Society for 1891, p. 27, where, in reporting the histories of twenty-three mastoidectomies performed during the first eight months of that year, he says, speaking of the treatment of the wound after all diseased tissues had been removed, "The ear itself was carefully dried, plugged with a pledget of cotton or baked gauze, and baked gauze dressings applied over the mastoid region and the ear, in some few cases corrosive being used instead of the baked gauze; *in no case were drainage tubes or gauze introduced into the wound*, and no stitches were used. Twenty-four hours after the operation, unless previously required, the wound was re-opened and explored by means of a probe and syringed with weak corrosive or, preferably, weak permanganate solution, subsequent drainage being insured sufficiently in all cases by the daily probing, the wound being allowed to close from within and above as rapidly as possible, care being taken to preserve, however, by use of the probe at the daily dressing, a sufficient external opening to permit of free drainage and to allow the use of the curette should any smaller spicule of bone, detached subsequently to the operation and detected by the probing, require removal. With the cases thoroughly curetted this was rarely necessary.

"The best results as to time of recovery, including complete healing of the wound to the surface, were, of the twenty-three cases, one in six, one in seven, one in nine, one in eleven, and three in thirteen days after the operation."

It will thus be seen that in the first cases treated Dr. Blake was in the habit of probing the wound occasionally during the healing process, partially breaking up the clot, with the object of finding and releasing any possibly retained septic material or foreign body left through incomplete surgical work. Even with this amount of interference the period of recovery was much less than that attending wounds that had been packed with sterile gauze. In the following year Dr. Blake concluded, evidently having gained more confidence in the powers of blood-clot, to omit the probing of the wound at the dressings subsequent to the operation for, in a paper read before the same society (Tr. Am. Otol. Soc., 1892, p. 204), reporting a further series of mastoid operations, he says: "Of the three following cases in which the mastoid cavity was quite cleared of its cellular structure, one was subsequently dealt with by frequent probing, antiseptic syringing and dressing; in the other two cases the excavated mastoid cavity was allowed to fill in with blood-clot at the conclusion of the operation, then superficially irrigated with very hot water—so hot as just not to scald the skin. The edges of the cut were brought together, covered with a cheese-cloth pad, baked dressing and a bandage.

The first case healed in four weeks with a deeply depressed cicatrix.

Of the other two, one was practically healed in five days; the other, the first dressing was made on the third day, and on the fifth day a cotton collodion dressing only was required; and in both, the pain and fever incident to the mastoid disease were entirely relieved by the operation. The greater part of the wound healed practically by first intention, and the cicatrix was insignificant."

Comparison of the results in these cases is very striking. As with so many other discoveries, the first incentive to this investigation came accidentally. A case of acute suppurative mastoiditis which had been submitted to operation and dressed under blood-clot developed an erysipelas of the scalp and face which prevented re-opening of the wound as was then customary. The erysipelatous inflammation ran its course in about ten days and when the dressings were removed from the mastoid the wound was found to be completely healed. The suggestions growing out of this experience led to the comparison in the small group of cases reported above and, later, to its trial in many more.

The next progressive step is related in another paper to the American Otological Society in 1898 (Tr. Am. Otol. Soc., 1898, p. 32), wherein Dr. Blake says: "With the accruing evidence of the possibility of safely avoiding the process of packing and dressing mastoid wounds after mastoid evacuation, came the question of differentiation in the determination of the class of cases to which this method was applicable, and the later series of observations has been made to include the application of the blood-clot dressing to all mastoid operations in the series, including even those of chronic suppurative middle ear and mastoid disease, and excepting only those cases in which the extent of the operative field made it necessary to resort to packing for other reasons.

"The admissibility of this line of investigation in the chronic suppurative cases, where the procedure was not expected to be a success so far as primal healing was concerned, was justified by the fact that the unsutured wound, if giving evidence at its first dressing, forty-eight hours after operation, or earlier, of infection of the blood-clot could be immediately opened painlessly by means of a blunt probe and the wound treated in accordance with its septic condition by cleansing and packing, and this without detriment to the patient by deferring this procedure to the time of the first dressing instead of packing at the time of operation.

"Thus in twenty-five cases of mastoid evacuation made the subject of the blood-clot experiment in 1896-7, sixteen were so-called acute cases, and nine cases of long continued suppuration with later mastoid implication. Of the sixteen acute cases,

seven recovered by primary healing and were discharged well, one in twelve days, two in eleven days, two in ten days, and two in eight days, thus giving an average of ten days. In the nine remaining acute cases and the nine chronic cases it was necessary to reopen the wound in the manner mentioned and allow it to heal by granulations from the bottom.

"In this series of twenty-five cases, therefore, the percentage of recovery in the time mentioned in acute cases is 43 per cent and in the total number of cases in this series 28 per cent."

At about this same time a somewhat similar series of operations were being performed and an analogous method developed by Professor Küster, of Marburg. His operation has never been widely adopted but its success was in the main dependent upon the same principle involved in Dr. Blake's work—the value of rapid healing under blood-clot. In the Journal of the American Medical Association for November 2, 1907, p. 1505, Küster says: "Under the title 'Ueber die Grundsaetze der Behandlung von Eiterungen in starrwandigen Hoehlen' (On the principles of treatment of suppuration in stiff-walled cavities) I published in 1889 an essay in which I recommended a broad opening of suppurating sinuses in the pleura, the cavities of the forehead, upper jaw and mastoid process, and proved the efficacy of the method in many cases. At first I made simple incisions to the bone, which I later changed in accordance with the principles of osteoplastic surgery to avoid deformities.

"I am very glad to find that the principles of operation which I then stated have been the basis of the development of this part of otiatric science. Still it must be acknowledged that a great many improvements in technic and instruments have been added to the primary method. However, after demonstrating that the opening of the mastoid by a straight-lined incision often produces an ugly deformity in the shape of a deep cavity behind the ear, I began in 1895 to form an oblong flap with upper base out of the whole skin, periosteum and a thin layer of bone of the mastoid process. This flap is folded back, the antrum, and in grave suppurations also the tympanic cavity, is opened with a chisel and after cleaning the field of operation the flap is reimplanted. The cavity under the flap is filled up by granulations and heals in a few weeks. I performed many of these operations and had cosmetically good results. My publication was violently attacked by several aural surgeons. They said that the reimplantation flap must hinder the survey of the wound and that it must be impossible to observe the condition of the disease. I replied that the latter may be judged better without looking into the open wound, as this would not be without danger for the life of a bone. A continuous suppuration indicates the persistence of the disease and requires the re-examination of the wound by lifting the flap. In the majority of cases I saw a prompt and persistent healing in a few weeks. Further, my adversaries said that the straight-lined incision gives the same cosmetic results; meanwhile I, and other surgeons, have been obliged to cover by plastic operations very ugly holes behind the ear made by aural specialists. Such a result is prevented by forming a flap even without bone; but the normal vault is only to be obtained by osteoplastic operation."

It may be observed in passing that Küster's criticism of the usual mastoid operation, where healing by granulation is awaited, is perfectly fair and that the claims of advantage in this method are well founded. The operation is rather more difficult to perform than the one described by Blake and possesses no advantage over the latter; the deformities and persistent fistulæ that Küster complains of are not due to the straight-lined incision, but to the slow and imperfect process of healing; if the straight-lined incision be followed by a complete operation and the wound closed for primary healing under blood-clot, the results will be even better than those obtained by Küster.

Following the lead of Dr. Blake a steadily increasing number of operators have adopted the plan outlined in his report, until to-day the method is employed more or less frequently by many American otologists. The application of the method has been subjected to various modifications but no one has effected any materially beneficial alteration. Thus, some speak of a "modified blood-clot" operation, meaning that a small drain of some sort is inserted between the edges of the wound and left until the second dressing to prevent any possible tension on the sutured wound, by draining away any serum exuding from the clot; their results are fine and show a marked improvement over the old plan of providing drainage, but, inasmuch as equally satisfactory results are gained without this drain it would seem to serve no useful purpose. The most practical improvements suggested have been those bearing upon the cleansing of the wound, it having been shown by the author (J. Am. Med. Ass., March 31, 1906) that excessive efforts at chemical sterilization of the bone cavity tends to interfere with organization of the blood-clot, and, the subcutaneous suturing of the wound margins to effect better coaptation and consequently a reduction of the scar to a mere line.

2. Objections Raised Against the Method.

It was perfectly natural and proper that other surgeons should criticise this innovation upon an established form of procedure. It is a good rule to test all things and hold fast to that which is good. In surgery, particularly, must we be slow to accept unproven modifications. The patient's interest must be considered above any possible gain in time or labor to the physician and every precaution taken to safeguard the welfare of the patient. Therefore, it was not strange that men should hesitate to fill a bone cavity, made by the removal of infective material, with the patient's own blood and close, or even suture, the skin over that blood-filled wound. Fear of the possible consequences of enclosing in the wound some microscopic particles of infective material and, secondly, a belief that the normal blood-clot constituted a favorable medium for the growth of bacteria naturally accounted for a disinclination on the part of many to even try the method. I can conceive of no other important objections, and, so far as I am aware, these are the only ones that have been urged against it. No one has ever reported a fatal result attributable to the blood-clot dressing in surgery and the only risks spoken of are based upon theoretical reasoning or, rather, upon a vague fear of something happening.

3. Reasons for Considering Healthy Blood-clot a Safe Dressing for Wounds.

Let us consider these objections from a scientific point of view and ascertain in how far physiological experiments explain what happens when a clean cavity in bone is filled with healthy blood-clot and what power such a clot may have to overcome infective material that may have been inadvertently left in the wound. Experimental and clinical studies have shown that if *any* clean wound be filled with the patient's own blood, and safeguarded from later infection, the blood-clot tends to organize and new tissue, similar to that enclosing the clot, soon forms to replace the latter. The blood flowing into the wound cavity rapidly clots and the fibrinous frame work of this clot constitutes a scaffolding on which the new tissue is built. Fresh granulations spring from the walls of the cavity and grow out into the clot, forming a new fibrous connective tissue, the nature of which is further altered to accord in character to the surrounding cavity walls; that is, if the wound be made in bone, osteoblasts are sent out from the bony walls or from the periosteum to convert the fibrous substance into osseous tissue. The migratory power of these osteoblasts is limited and they travel only a short way from their starting point so that, in the case of a large cavity in bone, the newly formed bone does not extend far from the cavity wall and the center of the new-formed tissue remains fibrous in character. It seems quite probable, however, that in a small cavity, such as we ordinarily have in the mastoid process, the osteoblasts reaching out from all directions, may extend a sufficient distance to meet in the center and thus to complete the construction of a new bony process. Just how early this osteoblastic activity commences is not known, but such cells have been observed to form within forty-eight hours after the operation and it is certain that granulation tissue grows more rapidly into a healthy blood-clot than into space. It is plain, then, that nature may be greatly aided in the reconstruction of destroyed tissue by providing an excellent frame-work on which to build and leaving her only the task of furnishing vascularity and new tissue cells.

Some very interesting observations upon the regeneration of bone have been made in recent years, through animal experimentations, by Dr. E. H. Nichols, of Boston (J. Am. Med. Ass., 1904, Vol. XLII, p. 439), and Dr. H. S. Vieder, of Philadelphia (Univ. of Penn. Med. Bull., 1908 Vol. XX, p. 109). After explaining the process of regeneration Nichols states that the power of repair of dense cortical bone is very slight or practically wanting and that removal of sequestra leaves a more or less extensive cavity in the bone, surrounded by a wall of dense bone lined with unhealthy granulations, which has no tendency to close. He further observes that the most satisfactory methods ordinarily recommended for the closure of such defects are the aseptic blood-clot, or obliteration of the cavity and approximation of skin flaps. Wieder's experiments concerned themselves more particularly with the exact process of regeneration and in ascertaining the source of osteogenesis. He proves pretty conclusively that in the regeneration of bone all of the various elements, viz., periosteum, cortex, endosteum and marrow, participate in the process, but that the periosteum plays a minor part as compared with the amount of new bone furnished directly from the surrounding bony walls. This is exactly in accordance with the views expressed by MacEwen many years ago (Annals of Surgery, 1887, Vol. VI, p. 289) and would seem, furthermore, to point to a possible additional advantage in the Küster operation, which leaves the largest possible area of bone surface capable of furnishing osteoblasts.

The second point that we wish to consider has to do with the properties of the blood, the dressing which we are introducing into the wound cavity. Let us suppose that this cavity has not been made absolutely clean, that some invisible particle of septic material is present when the blood is introduced, has the blood any bactericidal or antitoxic powers? A long series of observations by the most careful investigators has clearly proved that the normal human blood *does* possess such properties. Metchnikoff, Nuttall, Fodr, Lubarsch, Vaughan and Novy, and a host of others, have published most interesting works on this subject. From their several experiences we may safely draw the following conclusions: The normal human blood possesses bactericidal power, varying in degree in its antagonism to different microorganisms; the microbe-destroying substance is found in the serum, but is produced by the leucocytes; certain chemical changes in the blood may be induced either to increase or diminish its bactericidal power, and this property of the blood naturally diminishes after the clot is forty-eight hours old.

Nuttall, following the suggestion of Metchnikoff, was probably the first to demonstrate the bactericidal power of normal blood serum. Working under the direction of Flügge, in 1888, he used defibrinated blood taken from various species of animals and found that this blood destroyed the *Bacillus anthracis*, *Bacillus subtilis* and the *Staphylococcus pyogenes aureus* when brought into contact with them. He also confirmed the finding of Fodor that after a while the blood loses its germicidal properties and becomes a suitable culture medium in which germs grow abundantly.

The fact having been thus determined that the blood serum removed from the body acts far more rapidly and energetically on microbes than the plasma and lymph within the body, the disparity of action was further shown by Lubarsch (Allbutt's System of Medicine, Vol. I, p. 89) who attempted to ascertain the exact power of the blood of some animals over a given serum; using the bacillus of anthrax and experimenting on rabbits he injected known quantities into the circulating blood and found that this animal was quite able to take care of a dose of less than 16,000 germs, but if a larger number were injected fatal infection resulted. If he drew a small quantity of blood from an animal of the same class and size into a test tube and inoculated that with the same microorganism, many times that number of germs were destroyed. Then a most interesting series of investigations followed to determine what element of the blood possessed this bactericidal quality and how it acted. Vaughan and McClintock (Cellular Toxines, Fourth Edition,

1902) have presented the most conclusive report on these points and they hold that the leucocytes secrete some substance which is poured into the serum, that this substance is a proteid, and that the only proteid likely to be present in blood serum to which such properties could be attributed is nuclein.

The clotted blood possesses greater power than the circulating blood probably because in the formation of the clot the leucocytes break down and discharge their entire complement of this nuclein. Other workers have demonstrated the transient duration of this power in the blood-clot, a power which seems to diminish rapidly after forty-eight hours, and the fact that certain chemical changes in the clot may cause a variation of its power. The bactericidal power seems to be present in freshly drawn blood only when it is alkaline in reaction. If its alkalinity be raised above normal the bactericidal power will be somewhat enhanced, but if the blood be below normal alkalinity, or if it be rendered acid in reaction, such power is diminished or actually destroyed. The nuclein acts only in an alkaline serum. Again, if alcohol be added to the blood, the bactericidal property is destroyed through the precipitation of the albuminoid constituent. Bichloride of mercury, likewise, has a deleterious influence on the bactericidal properties of blood serum.

These chemical experiments, it may be said in passing, have an important bearing on the use of the blood-clot as a surgical dressing. The use of carbolic acid and alcohol for the cleansing of the wound, as an extra precaution of cleanliness prior to the introduction of the blood, has been recommended by some surgeons, but it seems not unreasonable to venture the suggestion that some of the failures with the blood-clot dressing may have been due to excessive zeal in the use of carbolic acid and alcohol for antiseptic purposes. If exact neutralization were possible and the wound left in a neutral state, no harm could result from the employment of these substances, but if there be left any measurable quantity of either it militates against success. On theoretical grounds it would appear more rational to rely on dry cleansing of the wound with instruments and sterile sponges or to wash the cavity with sterile salt solution which, if it produces any effect on the coming clot, renders it more alkaline and increases its power to control septic material.

4. Clinical Evidences in Support of the Method.

The author has been one of the most enthusiastic followers of Dr. Blake in the employment of the blood-clot dressing, even going further than the *master* would have advised; very little effort has been made to select the cases but, on the other hand, the blood-clot has been employed almost as a routine measure and upon all kinds of cases in order to determine its limitations, if there were any. The wounds have always been sutured tightly, without any provision whatever for drainage, sometimes with interrupted silk or catgut, occasionally with metal clamps, most commonly with subcutaneous silver wire suture. It mattered not in many of my cases that the amount of pus collected over the mastoid (subperiosteal abscess) had been excessive or that the entire cellular structure had been necrotic, nor indeed, that the sigmoid sinus or cerebral dural covering had been exposed by the disease or the operator; closure under blood-clot was frequently performed under such circumstances and numerous cases which looked utterly hopeless resulted in primary healing. In spite of trying it in these extreme cases and taking the most unusual chances, where the clot would be expected to break down, I have secured the highest percentage of successes. In a paper read before the American Otological Society in 1906 (Tr. Am. Otol. Soc., 1906, p. 385), I reported one hundred cases of mastoidectomy in which the primary healing of the mastoid wound was obtained in 72 per cent of cases, where the disease was the result of acute suppurative otitis media, and in 50 per cent of the cases that had originated in chronic purulent otitis. During the three years that have since elapsed not only has this high percentage of successes been maintained but improved upon. Between September, 1908, and May, 1909, my associate, Dr. Jesse W. Downey, Jr., and I had 16 consecutive primary healings; the 17th case, one of my own, broke down; this being all the cases operated upon by us in one institution, the Baltimore Eye, Ear and Throat Hospital, during that period. These were not selected cases but embraced all that came into my service in that institution and varied in character from simple mastoiditis limited to the antrum and neighboring cellular structures, to cases presenting extensive destruction of the cortex, exposure of the dura over the antrum and tympanic cavity, or of the sinus dural wall, and invasion of the soft tissues of the neck. The technic and team-work developed by us possibly accounts for our high percentage of successes but I could name many other operators who are securing very satisfactory results.

5. The Technic which Gives the Greatest Assurance of Primary Union in Blood-clot.

While Dr. Blake in his earliest reports on the use of this method called attention to the necessity of doing a very thorough operation, under strict aseptic precautions, if one would expect success, and while I have always felt that thoroughness in the removal of any possibly infected material and the nearest possible approach to an aseptic technic throughout every stage of the operation were of the greatest importance in the attempt to secure primary union of the wound, I was unwilling three years ago to attribute my own success entirely to good technic. To have done so would have seemed too much like a criticism of other men's methods and I had no reason to assume that my technic was materially different from that of others. During the past few years, however, my opinion on this point has somewhat changed. Close observation of the work of others as well as careful introspection has shown me that there are many opportunities for small differences in the work of men who think they are following the same technical rules. It is just these little things that lead very often to failure. There is nothing about the technic employed in the hospital where most of my work is done that is not recognized and endorsed by all surgeons and supposed to be a matter of routine with most of them. Insistence upon perfection in the details, accompanied by the enthusiastic assistance of my associates, is, possibly, the

main point of advantage in my service. Every one of my assistants is as anxious as am I to bring about a satisfactory result and rejoices with me over a primary union; many times I have found their hints helpful and they are encouraged to look out for errors in technic and to suggest improvements looking to greater facility or safety in the work; when one of them operates I serve as assistant and, by thus working together, my brother, Dr. J. N. Reik, Dr. Downey, Miss Dick (the Superintendent of Nurses), and I have developed a systematic procedure and a team-work which, I think, may account in large measure for our success.

It may not be amiss to briefly describe the preparation for, and conduct of, a mastoidectomy as performed in the Baltimore Eye, Ear and Throat Hospital:

Preparation of Patient.—Whenever possible we prefer to have the patient in the hospital at least over night and to operate early in the morning. The hair is cut and shaved from the scalp over an area which extends at least 3 cm. above and 6 cm. behind the auricle. This shaven area, together with the auricle, cheek and neck, down to the clavicle, is scrubbed with soft soap and water, using a stiff hand brush. All the soap is then removed by flushing the surface, including the external auditory canal, with warm sterile water. The surface is then mopped with gauze sponges soaked in a saturated solution of potassium permanganate and then the stain, thus produced, is removed by similar mopping with a saturated solution of oxalic acid. This is followed by a thorough rinsing of the whole area with a warm solution of mercury bichloride in the strength of 1-2000. A large pad of moist bichloride gauze is now laid over the entire field and a bandage applied to hold it tightly in position until the hour for operation. After anæsthetization the patient is placed on the operating table, a sterilized Kelly pad, covered with sterile towels, under the head, and the bandage and outer layers of gauze are removed. If the patient be a woman a sterile rubber cap is now put in place to protect the hair and to hold it as much as possible out of the way. A folded towel is laid over the face, vertically, in front of the auricle and a wet bichloride towel is then wound about the head, binding the upper end of the first towel in place and completely enclosing the rubber cap, in such a way as to leave only the auricle and mastoid region of the head exposed; a large sterile sheet, enveloping the patient's body and overhanging the table, having been drawn up to the chin and tucked under the shoulders. By a special frame-work attachment to the operating table, a smaller sheet having a central, circular opening of 15 cm. diameter is suspended over the patient's head, so that when fastened with safety pins to the towel over the face the patient's face and the anæsthetizer are absolutely shut off from the operation field and every portion of the patient and table is hidden save the field of operation as viewed through the opening referred to in the sheet over the head (Fig. 1).

Preparation of Instruments.—All the instruments selected for the operation, except knives and scissors, which are boiled separately, are wrapped in towels and boiled in soda solution and such packages are transferred to the instrument table unopened. One large and two small glass or metal topped tables are employed. The large table is covered with sterile towels and the surgeon or the instrument nurse unrolls the packages of instruments and spreads them out in a convenient way so that no time shall be wasted by the surgeon in searching for the next instrument required. One of the small tables is covered with a sterile towel and upon this are placed the sponges, sponge forceps and artery forceps that may be required by the assistant. The second small table supports two sterilized dishes, one containing carbolic acid solution and the other sterile water; the nurse stands behind this table to receive instruments from the surgeon after they have been used and with sterile gauze sponges wipes each instrument clean in the carbolic acid solution and rinses it in the water dish before replacing it upon the instrument table; this nurse goes through the same preparation for her duties as does the surgeon and assistant and sees that no instrument, once used, is taken up again until it has been cleansed (Fig. 2). During the interval between preparation of the instruments, sterile solutions and sponges and the moment of beginning the operation all of this paraphernalia on the tables is covered by sterile towels for protection.

Preparation of the Operator and his Assistants.—The surgeon and assistant remove all of their outer clothing and, over a sleeveless undershirt and drawers, put on sterilized white duck sleeveless shirt and trousers. Sterilized white canvas shoes replace the ordinary foot wear. The hands and arms, to a point above the elbow, are then scrubbed vigorously with a stiff brush, green soap and water for five minutes, particular attention being given to the finger nails. After rinsing in clean water the hands and arms are stained to the elbow in a saturated solution of potassium permanganate and then immersed in a saturated solution of oxalic acid until decolorized. Immersion in a 1-2000 bichloride of mercury solution for five minutes follows, and then a long-sleeved sterile gown, fitting tightly at the neck and enveloping the body to the knees is donned. A sterile cap is placed upon the head to entirely cover the hair and reach down on the forehead nearly to the eyebrows, and a gauze mask is placed over the face and tied behind the head so that only the eyes are visible. Rubber gloves that have been boiled are now drawn onto the hands while held immersed in bichloride solution (Fig. 3). Except for variation in garments, the same procedure is followed by the physician and nurse who are to assist the operator. If a head-light is to be worn, it, together with all connecting cords, is sterilized in a formaldehyde gas apparatus of the author's invention and put on over the cap when required.

Operation.—The details of operating need not be described; they vary in no important respect from those in general vogue to-day. The prime object is, of course, to thoroughly remove all necrotic or diseased bone and every particle of septic material. The aim is completeness and if there be any doubt as to the condition of tissue under inspection we prefer to consider it as probably inflamed or infected and to remove it, there being less danger of making an operation too extensive in these regions than of failing to completely eradicate diseased structures. Feeling that we have succeeded in this feature of the

FIG. 1.—Protection of the operation field. Anesthetist completely shut off.

FIG. 3.—Costume of the operator and protection of the field. The whole designed to render it impossible for anything not sterile to come into contact with the wound area.

FIG. 2.—Cleansing of used instruments by a clean nurse; so that no visible particles of infective material can be carried back to the wound.

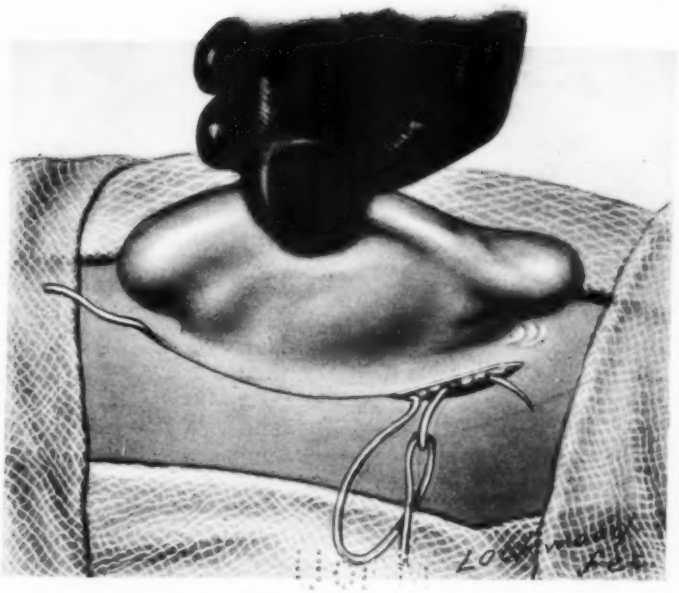

Fig. 4.—Primary closure by subcutaneous silver wire suture, after blood-clot dressing.

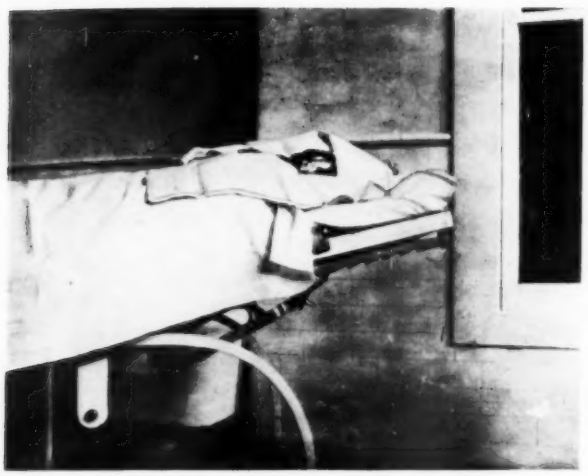

FIG. 5.—First dressing; fifth day after operation. Gauze dressings have been removed, but silver foil is still in place.

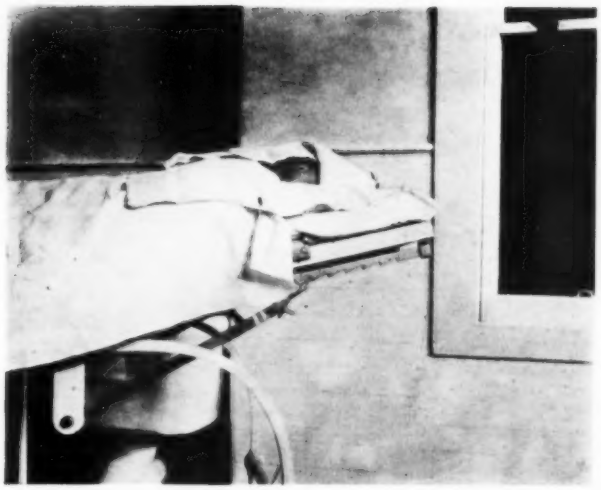

FIG. 6.—First dressing; fifth day after operation. Silver foil removed. Primary union.

FIG. 7.—Three weeks after operation. Practically no scar; the line of incision barely visible.

operation, the wound is irrigated with hot normal salt solution and fresh sterile towels are placed all about the operation field to cover the towels or sheets that have become soiled; occasionally we find it necessary to remove the first towels and sheets and to replace them with clean ones, to better assure a clean working field. Having dried out the wound cavity by mopping away the salt solution with sterile pledgets of gauze it is permitted to fill with blood and the edges of the incision are brought together neatly by a running subcutaneous suture of silver wire (Fig. 4). Ordinarily the oozing blood from the soft tissues that follows irrigation and drying by rubbing with gauze is quite sufficient to fill the cavity; if this should not happen it is an easy matter to provoke a slight hemorrhage by scraping the wounded subcutaneous tissues with the scalpel. Over the sutured wound, care having been taken to get nice coaptation of the edges, several sheets of sterilized silver foil are carefully laid and upon this a dressing of dry sterile gauze, in thin layers, is built up and the whole covered and held in place by a roller bandage. Unless there is some necessity arising for doing so, the bandages are not touched again for five days. Then, the dressings may be removed, the suture withdrawn and, if the wound has held, a layer of sterile gauze is applied and held in place for a few days by a protective bandage until union is firm.

After Dressings.—Should the clot become infected and break down it will almost surely be indicated by a continuance of the fever, by a return of febrile condition about the third day or by evident soaking of the dressings. I do not believe it is possible to suture such a wound so tightly as to prevent the escape of accumulating secretions; in other words, once you have made an opening into the mastoid that incision remains the direction of least resistance for inflammatory products. Not infrequently a case which has been running a high temperature prior to the operation will continue to show fever, usually of lesser degree, for the two or three days succeeding operation but that is not to be interpreted as due to infection of the blood-clot; it is the systemic fight with already absorbed toxines. Again, in milder cases, a temperature of 99° F. or 99.5° F. for 48 hours after such an operation is of no consequence and may possibly be due to some reaction not fully understood that accompanies healing under bloot-clot; at least, I have frequently observed that condition, and it in no way affected the result of primary union with perfect and permanent recovery. If the temperature, after 24 hours has elapsed, runs above 100° F. you may inspect the wound, but, otherwise, steer clear of the desire to meddle unnecessarily with the dressings. Should you find at the time of first dressing that pus is escaping from the incision, withdraw the suture, irrigate the wound and, if necessary, pack with gauze. Sometimes there will be simply a little superficial breaking of the clot and it will not be necessary to remove the entire clot or pack the wound; perfect primary union will not be the result in such cases but the period of granulation and healing by secondary intention will be greatly facilitated by leaving so much of the clot as has held firmly. When complete destruction of the blood-clot occurs and the entire wound has to be cleansed and packed the patient has lost practically nothing by the attempt to secure primary healing and the case will proceed exactly as it would have done had packing been resorted to originally (Figs. 5, 6, 7).

Finally, let me appeal to you to give this method a trial. Numerous operators have now demonstrated its practicability and we have shown that it was possible to secure primary union in 90 per cent of our last series of cases; even should you succeed in no more than 20 per cent of your attempts you will still have scored a triumph in surgery because for those few patients you will have greatly lessened the period of convalescence and secured the best cosmetic results to say nothing of the discomforts avoided.

THE PRESENT ATTITUDE OF THE TUBERCULOSIS NURSE TOWARDS HER WORK.

By Ellen N. La Motte,

Tuberculosis Nurse: Instructive Visiting Nurse Association of Baltimore.

The attitude of the tuberculosis nurse towards her work has undergone a complete change during the past five years. In order to know the reason for this change, we must know the attitude of the nurse in 1904. Her opinion at that time was but a reflection of that of the general public, which had been somewhat hastily and optimistically informed that tuberculosis was a curable and preventable disease. (That this could be accomplished only under ideal conditions was not mentioned.) The consumptive failed to recover because he was ignorant—he spread the disease because he was ignorant, and to dispel this ignorance, therefore, by careful house-to-house visits of instruction was the mission of the tuberculosis nurse.

The nurse of five years ago was as ignorant about tuberculosis, however, as is the average nurse of to-day. I will not say more so—at least as ignorant. The nurse just graduated from a training school has but the most elemental ideas in regard to tuberculosis, but it is not her fault. No hospital will admit such patients, and she has no way of seeing them. When by chance a consumptive is admitted to a ward, he is turned out again as promptly as his condition will allow. Such casual acquaintance with typhoid fever, for example, would not equip a nurse in any practical manner to deal with it, yet we somehow expect nurses to possess a degree of information about tuberculosis that is carefully denied them. One person more hopelessly ignorant than the average nurse is the average medical student or doctor. Yet to these two classes of people,

whom the hospitals do not properly equip, do we turn for light and leadership in the anti-tuberculosis crusade.

The nurse of five years ago, therefore, began her work with little or no knowledge of her subject. To her it was a vague medical problem to which certain platitudes were applicable. That it was a social problem, and a social problem alone, was utterly beyond her. Her ideas were about as follows: Tuberculosis is a curable and preventable disease. All that was necessary was to explain this fact to the patients, and they would live their lives accordingly. Milk and eggs are good for consumptives. If the patients were too poor to buy them, let them be supplied by the charity organization. The disease is spread by means of the sputum. The careful consumptive is not a menace. This equipment was very simple but very logical. It was merely a question of repeating this often enough to the patients to make the required impression. It was merely necessary to state an obvious truth, and results would follow.

It is an interesting fact to note that all tuberculosis work in a community begins in just this way. All new nurses, all new dispensaries, all new anti-tuberculosis societies, go through this stage. Unfortunately it takes several years to pass through it. The present attitude of the lay public to-day has not progressed beyond this view-point.

This, then, being the way the nurse began her work, her stages of progress were as follows: She attempted to educate her patients, and she herself became educated. She found that simply telling people what to do and how to do it, was not in the least synonymous with having them do it the minute her back was turned. She found that most of her teaching was disregarded—her patients careless, grossly careless, yet often with the blandest confidence that they were doing the right thing. She found intelligent people stubborn, and ignorant people so crushed by circumstance, so handicapped by poverty and conditions that they were unable or unwilling to follow advice. In certain conditions she appealed to the charity organization for aid, and got it—in inadequate amount. But this is right—it is not the function of the charity organization to abolish disease, and lavish relief (could such a thing be obtained) is not the way to stamp out tuberculosis. A great step forward is made when a nurse realizes the folly of asking for milk and eggs for a patient whose whole character and manner of life preclude the chance of recovery. As far as benefit to the patient was concerned, she found but temporary results. By means of her teachings, some few patients were enabled to "get along" in a more or less hap-hazard fashion. Of course an absolutely starved patient *does* gain a few pound if he is fed properly for a few weeks. But for the most part this gain is but temporary.

Many nurses leave the work too soon—they give it up at the end of a year or so, having acquired certain half truths which they disseminate among a gullible public and do great harm thereby. For instance John Smith makes a gain of twenty pounds in a few weeks and returns to work. At that point the nurse leaves the work but continues to talk about John Smith, and the charitable agency calls attention to its wonderful constructive work in having supplied John Smith with the milk and eggs which enabled him to return to work after having gained all those pounds. Could John be followed a year longer, however, he would be found able to work only two days a week, and his eldest daughter would have become infected. Another year, and John is sitting around the house all day, while his wife is at work, and another child has contracted the disease. The public's attention is not called to that sort of constructive work, however. It seems a policy of doubtful wisdom to enable a certain number of patients to "get along" for a period of months or years—working part of the time, sick part of the time, yet spreading the disease all the time. Prolonging a center of infection, while not at the same time producing adequate carefulness, is not a solution of the tuberculosis problem.

Much has been written about the sanatorium as an educator. When it comes to educating the very poor, the class of patients with which the nurse deals, the sanatorium is as ineffectual as she is. The sanatorium is useless for poor people—for them there is no cure. Unless the means of life are at hand in such abundance as to procure freedom from worry, rest, good food, shelter and clothing, the sanatorium avails the patient nothing. His discharge into an environment that he cannot control, means relapse. The sanatorium as an educator is as nothing compared to the tearing down of such "education" by crushing poverty and degrading living conditions.

During the first year that the writer did tuberculosis work, from June, 1905, to June, 1906, she personally visited 521 patients. Not a few times, but over and over again. Of that number 283 have since died. So much for the personal benefit to the patient. There have been 132 lost. They moved out of the city, or their addresses became lost in various ways. What has become of them is unknown. There are still 106 patients on our visiting list to-day, living after a period of five years' careful instruction. I should not call them well, but they can get along after a fashion, and any sanatorium would be proud of them. The degree of health they possess would not satisfy you nor me, but it satisfies them. These 106 patients, however, whom we have taught so carefully how to live and how to protect others, have succeeded, in spite of all we could do, in spreading the disease to 64 other people, who are now also on our visiting list to-day. In other words, these 106 patients whom we have so carefully instructed, have spread tuberculosis among sixty per cent of their number *that we know of*, and what they have done to other people *whom we do not know* is a matter of conjecture. These sixty-four people were all apparently well when we began to visit the original patients five years ago, and they have all of them contracted tuberculosis apparently within the last two or three years. Of course there may have been other avenues of infection through which the disease was contracted, but from the point of view of a nurse, these sixty-four patients had ample opportunity of contracting tuberculosis from sources with which we know them to be in daily contact. And it is reasonable to suppose that the 132 patients whom we lost, if they are still living, are also keeping up their share of destruction. But the question, however, is

with these carefully taught patients, who were not ignorant and whose families were not ignorant of the nature of their disease. Further comment is unnecessary.

We feel, therefore, those of us to whom continuity of service has given a broad horizon and experience, that the home is not the place for a patient with tuberculosis. In spite of the utmost teaching, and in spite of the utmost cooperation, there are a hundred reasons due to poverty, environment and temperament, that nullify all attempts at adequate carefulness. The patient cannot be properly careful in his home life, and the element of danger to his family and the community is ever present. In homes of the class we visit, the technique of the sanatorium cannot be applied.

What then is the present attitude of the nurse to tuberculosis work and what is her value to the community? Her chief value lies in her ability to put facts before the public. If for no other reason than just this alone—her conviction of failure in the direction from which so much was expected—she would have justified her existence during the past five years. She can teach in the homes and see the futility of her teaching—she can send early cases to a sanatorium and see the futility of their cure—and she must be forced to realize that a community with such a disease in its midst has but a flimsy protection in an "education" that is disregarded, no matter for what cause.

She must now be regarded, not as the end, but as the means to the end. The end of the question lies in the establishment of large and comfortable hospitals for advanced cases, and a segregation that would be for the most part voluntary. Hundreds and hundreds of advanced cases have begged in vain for admission to our sanatoria. Could they have been admitted, we should have had no further early cases. When a doctor examining an applicant, says to a nurse "All these cases are too advanced—can't you send me some nice early ones," and she replies, "Yes, in about six months I'll have a lot," the situation becomes absurd.

The work of the nurse to-day does not mean prevention nor cure, except in a certain small proportion of instances. She is, however, an educator of the first rank, but her mission is to educate people with tuberculosis to go out of their homes rather than stay in them. She can discover cases, bring or send them to dispensaries for diagnosis, instruct as to fumigation, and cleaning, give nursing service to ill patients, but above all she must teach the patients to go into hospitals that an enlightened public must provide.

CORRESPONDENCE.

Editor Bulletin of the Johns Hopkins Hospital.

Sir.—In view of the recent work of Col. C. T. Woodruff, of the U. S. Army Medical Corps, "Expansion of Races," reviewed in the January Bulletin, it is interesting to note the great Australian experiment in the use of white labor in tropical agriculture as detailed in the following extracts from "The Nineteenth Century and After" for February, 1910:

"'The attempt to acclimatise the white man in the tropics must be recognized to be a blunder of the first magnitude. All experiments based upon the idea are mere idle and empty enterprises foredoomed to failure.' Thus in 1898 wrote Mr. Benjamin Kidd in his 'Control of the Tropics' (p. 48), and his opinion was supported by the emphatic pronouncements of many other authorities. Nevertheless, in 1901, the Australian Parliament passed a law—the Pacific Islanders Act—which prohibited the employment in Australia of indentured coloured labourers, and rendered the Australian sugar plantations dependent on white labour. It thus staked the existence of an important industry, and the loyalty to the Commonwealth of the second largest of its States, on the success of a new and daring policy. The Australian experiment is the greatest practical attempt yet made to solve the problem whether the waste spaces of the tropics can be developed as white colonies instead of as black dependencies."

"A Royal Commission upon the Queensland Sugar Industry in 1889 had reported that for the area north of Townsville 'there was absolute unanimity amongst all the witnesses examined that white men could not cultivate cane,' and it quoted such opinions as 'withdrawal of black labour means shutting up the northern districts,' and that in those areas for 'five months in the year whites cannot work.'"

"The majority of the Commission declared 'it to be our opinion that if all coloured labour be withdrawn from the plantations, the extinction of the sugar industry must speedily follow, and we therefore recommend that the introduction of Polynesian labour be permitted to continue at all events for some years longer than the period now limited.'"

"According to Sir Malcom McEacharn the death-rate of the Kanakas from 1891-1895 was 42.73 per 1000 per annum; from 1896-1900 it was 30.08 per 1000. In 1902, at Mackay, it was 26 per 1000, and in 1903 about 32 per 1000, whereas among the white population, in spite of infant mortality and deaths from old age being included, it was only 12 per 1000."

"It has been said that though men may withstand the climate it is so injurious to children that they grow up feeble and degenerate. On inquiry at the Education Department at Brisbane I was informed that 'there is no indication in the inspectors' reports that the Northern children are less industrious or less fit for a long day's work than those in the South.' Such evidence shows that the white children of tropical Queensland are not weak, anæmic degenerates, while the increased output of sugar since the deportation of the Kanakas shows that white men are willing and able to work there."

"It may be thought that white labour has not yet been used long enough to have passed out of the experimental stage, but it has unquestionably already falsified the forecasts of inevitable ruin, and allayed the fears of many who believed that white men could not do agricultural work, nor their families thrive, in such an ultra-tropical climate as prevails along the coastlands of tropical Queensland."

It is evident that we need more testimony of this character before the question can be considered settled.

George M. Gould.

Ithaca, Feb. 25, 1910.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS MEDICAL SOCIETY.

December 20, 1909.

Dr. Louis Hamman in the chair.

I. Exhibition of Specimens and Cases. Dr. G. L. Hunner.

Dr. Hunner exhibited two interesting gynecological specimens. The first was that of a large fibroid of the uterus which had undergone malignant changes. In this particular case there was no particular complaint other than the size of the mass which simulated a well advanced pregnancy, there was no pain and very slight discomfort.

The second specimen was a large ovarian cyst with a twisted pedicle. This patient had suffered with three sharp attacks of pain in the region of the appendix.

II. Nitrous-Oxid-Oxygen Anæsthesia by Means of Rebreathing and Various Therapeutic Uses of Rebreathing. Dr. Willis D. Gatch.

This paper will appear in a later number of the Bulletin.

III. Report of a Case of Strongyloides stercoralis with Marked Eosinophilia. Dr. W. A. Baetjer.

This case of strongyloid infection is reported chiefly on account of the high grade of eosinophilia occurring in a case of intestinal parasitism. Strongyloid infection itself is apparently quite uncommon in this country, only fourteen cases having been reported up to the present time, the first by Strong in 1901. Six more cases are to be found in the Johns Hopkins Hospital statistics which together with this case makes a total number of twenty-one cases in all.

The patient is a young girl of twenty-two years, who entered the hospital on December 7, 1909, complaining of shortness of breath and swelling of the ankles and feet. Her personal and family history is entirely negative; she has always lived in Maryland and has never been out of the State.

The onset of her present illness dates back to July, 1907. Since that time she has had recurring attacks of dyspnœa and weakness but no diarrhœa or intestinal symptoms of any kind. Her physical examination revealed only an extreme pallor of the skin and mucous membranes. The examination of her blood showed 4,186,000 red corpuscles, 11,100 leucocytes, and 30 per cent hæmoglobin (Sahli). Differential count:

Polymorphonuclears	30.5 per cent.
Eosinophiles	45.0 "
Lymphocytes	23.0 "
Large mononuclears	6.0 "

The eosinophile count in this case is higher than in any other case in the hospital statistics except the counts reported by Brown in cases of trichinosis.

Examination of the stools showed numerous actively motile rhabditiform embryos which on incubation changed directly into the filariform larvæ and in no instance could the free living sexual forms be cultivated. No adult worms or eggs were found. On account of the frequent association of uncinariasis with this infection, sedimentation methods with salt solution and the method described by Bass were tried, but without results. The direct metamorphosis of the rhabditiform into the filariform larvæ has been the rule in all these cases, the sexual forms having been grown in but one of the cases in all the twenty-one collected. The ova were found in four cases but the adult female in none. A moderate grade of anæmia was found in most of the cases although this is hard to estimate owing to the number of cases presenting complications, but in no uncomplicated case was there noted a chlorotic anæmia as marked as in the present instance.

Of the twenty-one cases collected, ten were natives of or had lived in one of the tropical countries, four came from the Southern States, while three of the other seven had never been out of the State of Maryland.

The most striking feature of the present case, however, was the marked eosinophilia of 45 per cent on the day of admission. Of the cases reported thus far there was an eosinophilia in five, the percentages varying between 6 and 13 per cent. except in one case in which these cells constituted 38 per cent of the white blood cells. In several of the cases of strongyloid infection with eosinophilia, it has been noted that these cells have decreased in proportion as the symptoms abated and after the administration of tæniafuges, the decrease being associated with a concomitant rise in the proportion of polymorphonuclear cells. A similar observation was made some years ago by Brown in the cases of trichinosis.

This observation is well illustrated in the present case in which the eosinophiles counted after the administration of three courses of thymol (3ii) had dropped to 10 per cent with a simultaneous increase in the polymorphonuclear cells from 30.5 to 55 per cent. Since the second course of thymol over three weeks ago no parasites have been found although the stools have been examined daily. The patient's hæmoglobin which was 50 per cent on admission has now risen to 85 per cent and she is apparently rid of her infection.

IV. Demonstration of a Method of Producing Normal and Abnormal Heart Sounds for Teaching Purposes. Dr. C. W. Larned.

This paper appeared in the Johns Hopkins Hospital Bulletin for February, 1910.

January 17, 1910.

Meeting of The Johns Hopkins Medical Society, Dr. Louis Hamman in the chair.

I. Experimental Poliomyelitis. Dr. Simon Flexner.

In 1907 Dr. Flexner first began his studies on Experimental Poliomyeletis and attempts at that time were made to transmit the disease to the lower monkeys.

Owing to the fact that access was not possible to a single fatal case of the disease during the years 1907 and 1908, work was done only with the fluid obtained from the spinal canal

and this fluid seemed incapable of setting up any recognizable pathological condition when inoculated into laboratory animals including the monkeys.

In 1909, however, material was obtained from two fatal cases of infantile paralysis in human beings, the first dying from five to six days after the appearance of the paralysis, the second four days after the onset of the disease.

In one of these cases the entire spinal cord was obtained twelve hours after death and inoculated into animals, four hours later. The virus was obtained by making an emulsion in salt solution of the spinal cord.

In order to favor the transmission of the disease to monkeys the brain was chosen for the site of inoculation, which was made under ether anæsthesia, through a small trephine opening. In the careful study of 81 monkeys inoculated successfully with the virus of epidemic poliomyelitis we find the following features present.

Incubation period was calculated from the time of the inoculation to the onset of definite symptoms of the disease. The shortest period being four days the longest thirty-three days, the average about nine days.

Prodromal Signs.—When the virus is inoculated directly into the brain or other parts no immediate effects are produced. From six to forty-eight hours later, the animals become nervous and excitable and a slight tremor of the head, face and limbs can be noticed. The temperature does not rise constantly during the incubation period and gastro-intestinal symptoms rarely occur.

Onset of Paralysis.—The development of the paralysis is sudden and the muscles first involved are generally the larger group of the voluntary muscles. The muscle groups of both legs were involved in 20 monkeys, the right leg alone in 8 cases, and the left in 12 cases. Both arms in 3 cases and the right and left arm alone in each of 9 cases. Eight cases showed bulbar or cerebral paralysis. Marked spasticity of the limbs and incoordination, epileptiform convulsions with tonic and clonic muscle spasms and finally sudden death of apoplectiform type. When cerebral symptoms appear death follows usually within half an hour.

The paralysis extends quite rapidly from one group to another, in some mild cases the transition may pass unnoticed but in severe cases the passage is rapid from one limb to another, to the back, and the neck, until death ensues.

The termination of the disease is not always fatal, the affected monkeys may recover, the paralysis reaching a maximum, remains stationary and then recedes. Usually within a week in the mild cases, the animal regains its health and general strength except for the actually paralyzed muscles.

In those animals which die, the force of the affection is directed upon the medulla early in the disease, and death may occur within a short time after the appearance of the first symptom.

The Nature of the Virus.—Though the microorganisms of poliomyelitis cannot be affirmed at present many interesting facts concerning the nature and resistance of the virus have been determined. Film preparations and sections from the human and monkey's spinal cord have shown no bacterial or protozoal parasites. The filterability of the virus has been demonstrated and these bacteriologically clear filtrates have been used repeatedly to inoculate monkeys. From the inoculated monkeys the virus has been transferred to other monkeys and has regularly caused paralysis. The virus of poliomyelitis, in common with the filterable viruses of other diseases is resistant to injurious agencies. It will retain its virulence on being kept frozen at —2 to —4° C. for at least 40 days and will keep at least 50 days at a temperature of +4° C. The virus will resist glycerination for at least 7 days and resists drying over caustic potash in a dessicator for the same length of time.

The virus is readily injured by heating, a temperature of 45°—50° C. maintained for one-half an hour will render the filtrate incapable of producing paralysis. The results of the attempts at cultivating the virus of poliomyelitis in test tubes are in doubt.

The question of immunity also is not settled, although in experiments a period is found immediately following an attack of poliomyelitis during which the monkeys are refractory to reinoculation with the active virus. Just how enduring the immunity is, is still to be determined.

There is no reliable way of estimating, the virulence of the virus, since the number of the organisms inoculated is not subject to control. There are many avenues for transmitting the virus to the central nervous system of the monkeys and it is of prime importance to determine the portal of infection in man.

The lymphatics of the nasal and pharyngeal mucosa through the cribiform plate forms the most direct connection existing between the meninges and the external world. It has been possible on account of the filterability of the virus, which process would eliminate all bacteria, that the virus may escape from the meninges by this route. The accomplished infection by this route is still to be determined. It can be assumed that the monkey is relatively unsusceptible and hence difficult to infect through the natural channel. The lesions in the spinal cord and medulla of the monkeys, visible to the naked eye, consists of congestion and hemorrhage into the gray matter chiefly, but not exclusively confined to the anterior horns. The general appearances of the spinal cord, medulla and brain are not greatly altered, and the visible effects are no proper measure of the damage inflicted by the virus.

Microscopically, however, the vascular lesions are found to be the primary causes of the lesions of the nervous system, the severity of which is determined by the particular vessels affected and the intensity of the involvement.

No part of the spinal cord is spared and the medulla probably never entirely escapes injury. The degree of affection is determined by the richness of the arterial blood supply, whence is explained the liability of the lumbar and cervical enlargements to severe lesions.

Discussion.

Dr. L. F. Barker.—Those of us who see cases of this disease clinically in human beings must be much impressed with the experimental studies of Dr. Flexner. One feature of acute

anterior poliomyelitis which is discouraging to clinicians is the sudden onset of the paralysis (usually in maximal intensity and distribution) without forewarning sufficient to permit one to suspect the nature of the infection. Since the damage is done before a diagnosis can be made much more is to be hoped from preventive measures than from therapy. The greatest hope for prevention lies in such experimental work as Dr. Flexner is doing, for through study of the disease in animals it may, as he has emphasized, become possible to discover the way in which the virus is given off from infected individuals and the way it enters the bodies of the susceptible.

Reading in the library this week I noticed a report from Levaditi and Landsteiner which if verified ought to be of importance. These investigators assert that they have demonstrated the existence of the virus of acute anterior poliomyelitis in the salivary glands of the infected and they assume that the disease may be spread by way of the saliva. Dr. Flexner's ideas regarding the exit of the virus from the central nervous system by way of the naso-pharynx would fit in very well with Levaditi and Landsteiner's observations. One might think that the salivary glands become infected in this disease in the manner so often met with in bacterial infections of the salivary glands; namely, by way of extension from the buccal cavity along the salivary ducts. Though the suggestion has not been made, it seems to me easily conceivable that such salivary gland infection might explain the existence of virus-carriers for this disease. Just as after typhoid fever the gall bladder may long harbor living typhoid bacilli which, regularly or at intervals, are given off into the external world through the fæces, so it is easily thinkable that a certain number of individuals who have suffered from acute anterior poliomyelitis and have recovered therefrom may harbor the virus in the salivary glands and from time to time give it off through the saliva into the environment. Such carriers, should they be shown to exist, would help to explain the sporadic cases of poliomyelitis, the origin of which has hitherto been so puzzling. The idea of salivary infection is interesting also in connection with the apparent demonstration by Wickmann of contact infection in this disease.

The fact that the disease is due to a filterable virus, that its main expression is in the central nervous system and that the salivary glands become infected make its resemblance to rabies very close. Unfortunately experiments thus far made in preventive inoculation with dried spinal cords during the incubation period, have not been successful.

In the cases of acute anterior poliomyelitis which I have personally had the opportunity of observing the severe pains and stiffness of the limbs and neck at onset have been conspicuous features. These symptoms are probably due to meningeal involvement and a great deal more stress than formerly is laid now upon this feature of the disease. In a child I saw with Dr. Field, of Coburg, a few years ago the pains in the limbs and back were extremely severe and movement of the limbs caused so much pain that an acute articular rheumatism was thought of at the onset. A few days later the flaccid paralysis of both lower extremities and one arm unmasked the real nature of the disease.

Histological studies of the nervous tissues such as Dr. Flexner has demonstrated to us in lantern slides tonight are very instructive. They show how much more extensive the involvement of the whole nervous system is than one would suspect from the clinical symptoms observed. The disease process is not confined to the ventral horns at all but may involve all parts of the gray matter of the cord, the white matter, the meninges and the posterior root ganglia. More than this, the medulla oblongata, the pons, the basal ganglia and even the cerebral cortex show definite alterations of the same type as those met with in the cord itself. We can now begin to understand why it is that at times when anterior poliomyelitis is occurring in epidemic form, cases of acute disease of the central nervous system other than the typical flaccid paralyses due to anterior poliomyelitis are met with. Among these may be mentioned cases which simulate meningitis, others which simulate polyneuritis, others running the course of an acute ascending or descending spinal paralysis, others presenting the phenomena of bulbo-pontine palsies, others showing signs of a rapidly developing general ataxia and still others pursuing the course and presenting the phenomena of acute encephalitis with cerebral palsies of spastic type and with disturbances of intelligence. Only this autumn I saw here in town with Dr. Shearer a boy who two weeks after leaving a community in which acute anterior poliomyelitis had been epidemic suddenly developed acute symptoms which at first were very puzzling, but which we concluded were due to meningeal involvement and to lesions in the pons and medulla oblongata. There were no flaccid paralyses and the symptoms, though alarming for a time, gradually cleared up. Dr. von Pirquet also saw the case and will recall the difficulties of diagnosis.

This leads me to say a word regarding the nosological position of what we have been accustomed to call acute anterior poliomyelitis. It would seem, as those who have studied the northern epidemics especially have been led to believe, that acute anterior poliomyelitis is the most common expression, though not the only one, of a pathological process which involves more or less of the whole central nervous system. For some reason or another the cervical and lumbar enlargements of the spinal cord are most frequently and most severely involved in the pathological process, but higher parts of the nervous system may be concerned along with these and, in rare cases, without sufficient lesions in the cord to call forth flaccid paralyses. It has been suggested that the whole disease be called the "Heine-Medin disease" inasmuch as Heine and Medin gave the earlier important clinical descriptions. Dr. Flexner has already been able to produce experimentally in monkeys bulbar lesions sufficient to cause clinical paralyses and it will be interesting to find out whether or not all the forms of the Heine-Medin disease thus far observed, other than acute anterior poliomyelitis, may be produced in animals by experimental introduction of this same virus.

It is surprising how our classifications of disease become modified as soon as we get light regarding etiology. The etiology of acute diseases of the central nervous system has up to now been obscure and our classifications have depended almost wholly upon symptomatology rather than upon etiology.

Studies like these of anterior poliomyelitis promise to do for some of the nervous diseases what the discovery of the tubercle bacillus and its relations to various forms of tuberculosis has done in connection with pulmonary phthisis, scrofula, white swelling of joints, caries of bones, the serositides and lupus. It is becoming very clear that diseases of diverse parts of the nervous system presenting such different clinical phenomena that they have been described as wholly different diseases may be due to one and the same virus: thus each one of the eight or ten varieties of the Heine-Medin disease in human beings occurring in the same epidemic is probably due to one and the same virus, the different clinical picture depending upon the excessive localization of the pathological process in one or another part of the nervous system. Enthusiasts, however, should not run away with the idea that all acute processes in the central nervous system are due to the virus which causes epidemic poliomyelitis. That idea would be just as absurd as to assume that all of the infectious granulomata occurring in the body are due to the tubercle bacillus. Indeed, it seems now certain that acute infections of the meninges, acute myelitis acute encephalitis and even acute poliomyelitis may be due to different forms of infectious agents. I think it particularly interesting that Dr. Flexner has been able to study cases of poliomyelitis occurring spontaneously in the dog and in the chicken and to demonstrate that the virus obtained from the nervous system of these animals when injected into monkeys does not produce poliomyelitis in them. This would make it appear that poliomyelitis of the dog and of the chicken is due to some virus other than that which causes poliomyelitis in man and in monkeys.

As to the immunity conferred by one attack of acute anterior poliomyelitis in human beings, I may say that this immunity does not always develop quickly. While rare, relapses undoubtedly occur, and sometimes two or more relapses occur in the same individual, much as in typhoid fever. Whether or not there may be a second infection in later life with the same virus I do not know, though it is certain that persons who have suffered from acute anterior poliomyelitis leading to permanent paralysis of one lower extremity in childhood may in adult life develop a chronic anterior poliomyelitis or progressive muscular atrophy involving the other lower extremity. This phenomenon, however, is probably to be regarded as a late result of the first infection, the lower motor neurones having been so injured that they are unable later on to bear the strain of the wear and tear of life.

I would like to call attention to the great difficulty we sometimes experience in differentiating the Heine-Medin disease from acute multiple neuritis in children. It is rare to see cases of polyneuritis in children but they do occur and Dr. H. M. Thomas has made an especial study of them and has demonstrated them to us at this Society. Certain features are helpful in differentiation. The paralyses in multiple neuritis do not, as a rule, develop in their maximal distribution so abruptly as in poliomyelitis; usually at least several days or even weeks are required for the full development of the paralyses, in marked contrast with the non-progressive character of ordinary poliomyelitis. It must be borne in mind, however, and Foerster has recently emphasized this point, that occasionally in true anterior poliomyelitis the paralyses may progressively develop during a period of ten or twelve days. The pains in the muscles and nerves usually last longer in multiple neuritis than in poliomyelitis as does the fever, and sensory disturbances are much more common in neuritis, though in young children under three years of age this point is of little value for differential diagnosis since it is scarcely possible to make any adequate sensory analysis in patients so young. One differential point which I regard as of great significance, however, is the topography of the paralytic phenomena in the two diseases, especially in extremities in which only a portion of the muscles are involved. In multiple neuritis the paralyses correspond in topography to the distribution of the peripheral motor nerves, while in poliomyelitis the muscles involved are certain groups which are innervated by definite aggregations of nerve cells situated in the anterior horns of the spinal cord. Portions of different muscles concerned in the same synergistic activities become paralyzed in poliomyelitis so that the distribution here is wholly different from that corresponding to paralysis due to lesions of the peripheral motor nerves.

II. The Heart Muscle in Typhoid Fever. DR. LOUIS HAMMAN.

The anatomical lesions produced by typhoid fever in the heart and blood vessels have long been known. While there is much diversity of opinion about the extent and frequency of these lesions their occurrence and importance is unquestioned. In our study of 43 hearts from patients dying of typhoid fever, we were able to find some changes in practically all, although in most the lesions were not extensive enough to allow one to assume with certainty that the efficiency of the heart muscle was compromised. There is unfortunately no satisfactory evidence at hand to allow us to judge the functional capacity of the heart by the character and extent of the histological lesions and frequently the two seem not to run parallel. In at least six of our cases both the fibre and interstitial lesions were so intense that we could hardly associate their presence with complete efficiency of the organ. We do not find any evidence of wide-spread change in the smaller branches of the coronary arteries but frequently periarteritis and endarteritis in the large medium-sized branches. No doubt these lesions must in some degree interfere with the blood nutrition of the heart and are of importance both for the immediate efficiency of the organ and its future integrity.

There are certain symptoms during the course of an acute infectious disease which point directly to the presence of some cardiac lesion and often to cardiac insufficiency, notably irregularities of rhythm, and the physical signs of beginning dilatation. Certain sudden deaths can be satisfactorily explained only upon the assumption of abrupt cardiac failure. Römberg has claimed that during the height of an infection the circulatory failure depends entirely upon vasomotor paralysis. Even though the vasomotor system plays the important rôle the work of Stejskal shows that the heart is not always perfectly efficient and that it cannot be entirely disregarded as a

factor in the failure. It is during convalescence particularly that the symptoms of a damaged myocardium stand out most clearly. Such symptoms are not nearly so common after typhoid as after other infections, notably diphtheria, but they occur frequently enough to indicate the significance of the damage the heart has sustained.

Undoubtedly these lesions of the myocardium and of the arteries, principally the coronaries, are of the greatest importance for the future health of the individuals. We are being more and more impressed with the significance of infectious diseases in the production of chronic arterial and myocardial disease. Typhoid fever has not in this regard the same importance as rheumatism, syphilis, or diphtheria, but on account of its prevalence, it is a factor to be seriously reckoned with. The prevention of infectious diseases will probably prove one of the strongest prophylactic measures against the degenerative lesions of the circulatory system.

Discussion.

Dr. Hirschfelder.—In death from circulatory failure in infectious disease there is often no parallelism between the intensity of the demonstrable lesions and the failure of the circulation. The areas of infiltration and vacuolization in the heart muscle, mentioned by Dr. Hamman are in themselves too small to cause such great functional disturbance; and yet the failure of the circulation is due in great part to failure of the heart itself. Another cause must be sought for this. It is a failure of the heart muscle as a whole. There is a lowering of the tonicity of the heart muscle. It is the lowering of the tonus which distinguishes the diseased heart muscle from the healthy. This point is particularly well shown in phosphorus poisoning, a condition in which, as Dr. Hamman has pointed out, degeneration and the vacuolization of the fibres occur as they do in typhoid fever. De la Camp has found that if he caused dogs poisoned with phosphorus to run on a treadmill, their hearts became dilated from exercise which did not affect the size of the normal hearts at all, or if anything caused them to become smaller. Nevertheless there is often no change in blood pressure. Kraus also has called attention to similar observations in man, the dilatation occurring even when the blood pressure and cardiac outline before the effort were perfectly normal. The diminished tonicity of the heart muscle enables more blood to enter the heart during diastole, though the unchanged or diminished strength of the beat enables the heart to drive out only its usual quota of blood (systolic output). Dilatation therefore sets in through increase of the "residual blood." Any severe strain will tend to overfill a heart whose tonicity is much diminished, even to the point at which it can no longer carry out effectual contractions, and may thus bring about the death of the animal patient.

I should like to ask Dr. Hamman whether any difference has been found between the heart lesions in patients who had been given a liberal diet and those who had been given only milk and albumen during their illness. Schieffer has shown that a definite atrophy of the heart may occur from inanition alone; and since it is a well-known principle in pathology that the effect of two deleterious agents acting simultaneously is more intense than if they were acting at different times, it would be of interest to know whether the insufficient diet loss of body proteid which occurs upon a milk and albumen diet may not in itself act as a contributing factor which renders the increasing severity of the heart lesions due to typhoid fever. This is a question of particular importance since it has been shown by Dr. Voegtlin in this clinic, by Dr. Shaffer in New York, and by numerous European observers that much of the proteid loss of body proteid can be obviated by a diet rich in carbohydrates; and since clinical experience has shown that during convalescence, when the chief strain falls upon the circulatory system, the patients who have been upon a liberal diet are usually the stronger, and that the period required for convalescence has been shortened to about half what it was during the days of the restricted diet treatment.

III. Anerythraemic Erythraemia. Dr. Roger S. Morris.

This paper appeared in the Bulletin for February, 1910.

THE LAENNEC.

January 24, 1910.

Dr. Henry Barton Jacobs in the chair.

I. The Visiting Nurse's Attitude Towards Certain Tuberculosis Problems. Miss Ellen La Motte.

See current number.

II. Relative Importance of the Human and Bovine Types of Tubercle Bacillus in Human Tuberculosis. Dr. W. H. Park.

The investigations under Dr. Park's supervision have been directed towards the study of the frequency of occurrence of the bovine type of the tubercle bacillus, amongst the cases of tuberculosis, coming under his attention in the New York Health Department and in certain hospitals.

These investigations, by a number of workers in the Department laboratories, have been carried on over a period of two and a half years and are not yet fully completed. Dr. Charles Krumwiede, Jr., has had charge of the details of the work. That human beings may be infected with the bovine type of the tubercle bacillus has long been recognized. The source of the infection being usually milk and butter from tuberculous cattle. A very satisfactory differentiation of the two types—bovine and human—tubercle bacilli can be made on the egg and glycerine-egg media. The human type growing very much more luxuriantly in the early generations on the egg media. The addition of glycerine increases this difference as in most cases it inhibits the bovine culture and stimulates the growth of the human cultures.

The different schools vary in their idea of the permanence of the two species, many believing that one type may later assume the characteristics of the other type. The bovine type is thought by these persons to lead to more infections than the study of cultures would indicate since they believe many individuals are infected during infancy with the bovine type,

which later, changes over to the human type. That this or the reverse change is possible is suggested by the results of the recent British Commission, in an experiment in which several cultures of the human type of the bacillus were passed through calves, during which process the type of the bacillus was apparently changed to that of the bovine type. In other instances no change took place. It is considered by many that the apparent change in type was simply due to accidental infection of the calves with bovine bacilli.

In all of Dr. Park's experiments in calves the human type remained the human type throughout, and there was no tendency to change over to the bovine type. Furthermore, the bovine type was just as characteristic in the lymph glands, in which infection had existed for one or two years, as in the freshly infected cases. In 412 cases of tuberculosis, carefully studied, clinically and from portions of glands and tissue removed at operation or at autopsy, Dr. Park has found the relative occurrence of the two types of bacilli as follows:

412 Cases of Tuberculosis.

Diagnosis.	Adults. 16 years over.	Children			
		5-16 years.		Under 5 years.	
Type.	H.	H.	B.	H.	B.
Pulmonary	277	8	..	5	..
Cervical adenitis	9	19	7	5	11
Generalized	2	1	..	13	5
Generalized with meningitis	..	1	..	31	1
Bones and joints	1	10	..	6	..

It is interesting and important that the occurrence of the bovine type is practically limited to the cases under 16 years of age and with the larger proportion under five years of age. Above the age of 16 years the human type is practically the only type found.

In the study of 40 cases taken from the Babies' Hospital, New York City, Dr. Park finds over 10 per cent of the infections due to the bovine type of the bacilli, and he believes that his figures will show that, in general over 3 per cent of all the cases of tuberculosis are due to the bovine type. Dr. Park agrees with Dr. Koch, that as far as adults are concerned, the bovine type of the bacillus may be considered a negligible factor.

In the ordinary case of pulmonary tuberculosis we have not to deal with the bovine bacillus.

In infants and young children, however, bovine infection causes many deaths and deserves that we give serious consideration to its prevention. This can best be done by safeguarding the milk and butter supply of young children.

Discussion.

Dr. William Welch.—It is interesting to consider our knowledge of the bovine type of the bacillus, before Prof. Koch made his famous statements at the recent London Congress. For many years it was believed that there was no difference between the two types and it is true that this view is held by some even to the present day.

Dr. Park's investigations are most important and will when completed represent an infinite amount of time and painstaking work. His cases were not picked cases since they included also all the cases of ordinary tuberculosis, and therefore the statistics and results of his work will prove most valuable. It is suggestive that the infection in tuberculous meningitis is from other than an alimentary source since the bovine type of the bacillus is so rarely found.

NOTES ON NEW BOOKS.

Tuberculosis of the Nose and Throat. By Lorenzo B. Lockard, M. D., Laryngologist to the Jewish Consumptive Relief Society Sanatorium, etc. (*St. Louis: C. V. Mosby Company, 1909.*)

Dr. Lockard's work presents in good form the most exhaustive American treatise on tuberculosis of the upper air passages. After a short historical survey of the lesions of the various organs concerned, he presents in detail the symptoms, signs and treatment of the lesions in the larynx, nose and pharynx. He emphasizes the fact that the prognosis in this disease is not, as too frequently thought, hopeless. If recognized early, a great many of the cases can be cured or the process arrested.

The volume is well made up and will be a most valuable addition to the laryngologist's library.

Sylvan Rosenheim.

Modern Clinical Medicine: Diseases of Children. Edited by Abraham Jacobi, M. D., LL. D., etc. An authorized translation from "Die Deutsche Klinik" under the general editorial supervision of Julius L. Salinger, M. D. Illustrated. (*New York and London: D. Appleton & Co., 1910.*)

He must be a valiant critic who takes issue with the leader of American pædiatrists, the editor of this work, the greatly revered and respected Dr. Jacobi. In spite of the latter's enthusiasm for the book, it seems to the reviewer to have certain distinct limitations. In his preface Dr. Jacobi says: "The articles contained in it are all written by masters of national or international renown, are evidently weighed with care and circumspection, guided by learning, convey everything that is worth possessing, are complete but brief, brief but lucid, lucid and in part eloquent and easy reading. No extensive editing could have enhanced their value. As, moreover, the admirable translation by Dr. J. L. Salinger has provided a book at least as readable as the original, I recommend it to the attention of the professional public as a worthy and valuable addition to their libraries." (With such praise the publishers should have been satisfied and not asked for more or run the risk of having their work found fault with!) It is not our intention to be hypercritical, but a little over a page for "cerebrospinal meningitis" does not seem to deserve such words as those of the editor. In this unsatisfactory account of the disease there is no mention of any form of serum treatment. In the chapter on scarlet fever under "Prophylaxis and Treatment" it is stated "that, naturally, there should be a disinfection of all utensils and objects which have come into contact with the patient. . . . . It is impossible to enter here more minutely into these hygienic questions." Such cursory treatment of an important question in a text-book which is assumed to be first-class is not excusable. What notes the editor has added have enhanced the value of the book for American readers, and it is a pity that

there are not more of them. The work is too distinctly German to be appreciated by the average student or physician, for there is very little note taken of the work done by any one outside of Germany. To this fact the editor calls attention in his preface, and while we agree with him in thinking that such an exposition of German views is valuable, yet, except to the thorough student of pædiatrics, it does lessen the worth of the book to the average reader. The translation, lauded by the editor, is good, but due to the translator's desire "to adhere as closely as possible to the style and phraseology of the German authors," it is frequently not easy reading. It is practically impossible to render into fluent English the involved German phraseology, and it is not worth while to make the attempt, for German and English style in prose writing are too distinctly different to be harmonized. The few illustrations do not add merit to the book, but the charts are excellent. In spite of these reflections the book is a most valuable one for the advanced student of pædiatrics, who in comparatively small compass will find here the views of the leading German authorities in this science.

Fiske Fund Prize Dissertation. The Mode of Infection and Duration of the Infectious Period in Scarlet Fever. By CHARLES V. CHAPIN, M. D., Providence, R. I. (*Providence: Snow & Farnham Company, 1909.*)

The author has presented in his essay briefly and clearly the latest views on this subject, and the paper is one well worth careful reading. Infection is being observed from so many different points of view that theories held to-day may be upset to-morrow, and certainly until the cause of a fever is known, any theory as to its method of infection must be debatable. Dr. Chapin from his studies draws these, among other conclusions, that scarlet fever is most contagious during the first days of its appearance, that it is probably a local disease of the nose and throat and that the exfoliated epidermis is probably not infectious—all points of great interest, which, however, require further study before they can be accepted as proven.

Bacteriology for Nurses. By ISABEL MCISAAC. Price $1.25. (*New York: The Macmillan Company, 1909.*)

The authoress has written several works on nursing, and has acquired a too easy faculty of preparing handbooks of one sort or another. Her last work cannot be commended. It is not well composed. The chapter on tuberculosis, for example, might well have been written by a high school pupil; and there are throughout the book paragraphs which need emendation.

Treasury Department. Public Health and Marine Hospital Service of the United States. Hygienic Laboratory. Bulletin No. 52, October, 1909. Report No. 3 on the Origin and Prevalence of Typhoid Fever in the District of Columbia (1908). By M. J. ROSENAU, L. L. LUNSDEN and JOSEPH H. KASTLE. (*Washington: Government Printing Office, 1909.*)

Those who have read the first two reports on this subject by these authors will be anxious to read this third excellent and exhaustive one. It is doubtful whether there is any such thorough study of the fever in a community. The conclusions of the writers who have so painstakingly examined into all the conditions surrounding the prevalence of typhoid fever in Washington (D. C.) deserve the greatest respect and consideration by all students in hygiene. They state that "the results of three years of study show that the disinfection of excreta of patients is frequently inefficient or neglected, and that there is need of legal control of typhoid fever patients, and typhoid bacillus carriers." "We are convinced that a vigorous campaign against typhoid fever as a 'contagious' disease, and the adoption of measures that would prevent the spread of the infection in milk, would eliminate the greater part of typhoid fever from the District of Columbia."

Diet in Tuberculosis, with Costs of Foods and Their Preparation. By NOEL DEAN BARDSWELL, M. D., M. R. C. P., and JOHN ELLIS CHAPMAN, M. R. C. S., L. R. C. P. Price $1.00. (*Oxford University Press, American Branch, 35 West 32d Street, New York, 1910.*)

This pamphlet contains in a brief and practical form the results of investigations previously published, somewhat more extensively, in a volume entitled "Diets in Tuberculosis," which was reviewed in the JOHNS HOPKINS HOSPITAL BULLETIN for June, 1908. In this pamphlet are added many directions for the proper preparation of foods. It is a valuable and helpful treatise on the subject.

A Text-book upon the Pathogenic Bacteria. For Students of Medicine and Physicians. By JOSEPH MCFARLAND, M. D., Professor of Pathology and Bacteriology in the Medico-Chirurgical College, Philadelphia. Sixth Revised Edition. Illustrated. Price, $3.50. (*Philadelphia and London: W. B. Saunders Company, 1909.*)

The new edition of McFarland's Text-book upon the Pathogenic Bacteria presents but few points of difference between it and previous editions, upon which we have already had occasion to comment favorably. The book contains a vast amount of valuable information and the treatment of the majority of the topics is adequate. Mixed with this information, however, there is much that is erroneous, and many statements are made that are apt to lead the student far astray. In the chapter on Yellow Fever, to quote specific instances, over seven pages are devoted to the consideration of Bacillus X of Sternberg, Bacillus icteroides of Sanarelli, and the Bacillus of Havelburg. At no time was there any satisfactory evidence that these organisms were etiologically related to yellow fever, and with our present knowledge a detailed description of their properties is quite out of place in a chapter devoted to this disease. The most important work on yellow fever, the investigations of the American Commission, is dismissed with a scant three pages.

Much the same criticism may be expressed in regard to the chapter on Hog Cholera. The hog cholera bacillus is now admitted to have no definite etiological relationship to hog cholera, although it may play the rôle of a secondary invader. Uhlenhuth has shown, however, that this bacillus is not the only one to play this rôle in this disease, even Bacillus coli apparently being able to assume this function. Nearly 10 pages are devoted to this microorganism. None of the great advances in our knowledge of hog cholera begun by DeSchweinitz, worked out by Dorset, McBride and Bolton, and now confirmed by a number of investigators in Germany, France and Holland, are adequately presented, although the causation of this disease by an ultra-microscopic virus, and not by the hog cholera bacillus, is now almost universally accepted. At the same time little is said of the exceedingly interesting subject of the immunity of this disease, and the methods of vaccination adopted both abroad and in this country, in which thousands of swine are inoculated first with immune blood, then with virulent blood, or after inoculation with immune blood, are exposed to natural infection, are not even mentioned.

Surely in a text-book of bacteriology, published in America and written by an American, two of the most original and valuable pieces of investigation ever accomplished by American investigators should receive more extensive and more favorable comment than Dr. McFarland has accorded them.

It might also be stated that the bacillus described by Bordet and Gengou in pertussis, the presence of which in whooping-cough cannot be doubted, is apparently not mentioned.

In general we believe this book needs thorough revision, the elimination of many unimportant pages, and the incorporation of some of our recently acquired knowledge, in order that it can be recommended to students of bacteriology.

Diseases of the Stomach. A Manual for Practitioners and Students. By S. H. HABERSHON, M. A., M. D., F. R. C. P. Illustrated. Price, $2.50. (*Chicago: Chicago Medical Book Company, 1909.*)

We may say at once that the author of this work deserves our thanks for having written a work on gastric disorders without giving us a new classification and without coining new terms. Formerly nearly every writer on the subject thought it his duty to do both, but fortunately this tendency seems to have become less marked of late, for which we have cause to be grateful. The work opens with an excellent chapter on the anatomy of the stomach in which are some very good plates. Following this the writer takes up the subject of the physiology of the digestion and the importance of a thorough knowledge of this in handling the diseases of the digestive tract is only too evident. After this are chapters on diet and the methods of examination. In the discussion of the general symptoms of gastric disease it seems at times that the author has gone rather far afield and brought in other diseases. A large section is devoted to the discussion of dyspepsia, of which term the writer does not give an exact definition, but apparently uses it in a general way to characterize disturbances of the digestive function which perhaps cannot be easily classed anywhere. Certainly the term is a convenient one and, as the writer says, an exact classification is extremely difficult.

It is not possible to follow up every section in detail, but it may be said that the discussion throughout is to be thoroughly commended on the whole. There is thorough attention given to the subject of diet and to the employment of general measures. There are, however, two or three points which seem worthy of criticism. Thus, anorexia nervosa is discussed under the general heading of dyspepsia and under the subdivision of nervous dyspepsia of central origin. It seems a mistake to regard this disease as one of the digestive system. It is better considered as a severe general neurosis. The author notes that death has occurred and states that this could only happen in neglected cases. This is hardly correct, as the experience of this clinic has shown. A point which is open to criticism is the discussion of the diagnosis between cancer of the stomach and pernicious anæmia. The writer states that in the absence of a tumor the difficulties of diagnosis are increased by the character of the blood. This does not seem a correct statement as in doubtful cases it is to the study of the blood that we must turn to give the diagnosis. There is a rare case in which the diagnosis may be in doubt for a time, but this does not happen often. It is also rather surprising to find a man from London speaking of progressive pernicious anæmia as being originally described by Biermer. We were of the opinion that this honor belonged to Addison. A point which might be amended is the mention of the absence of digestive leucocytosis as a diagnostic sign of cancer of the stomach. This is mentioned with reference to an article written in the year 1894. It would have been better to have brought this subject up to date, because experience has shown that the absence of digestive leucocytosis is of little value as a diagnostic sign.

Altogether, however, we must say that Dr. Habershon has given us an excellent work and one which should be of much help to the student and practitioner. The directions for treatment are clear and satisfactory, while in the whole discussion the author has kept clear of fads and fancies, which many would say is as admirable as it is rare in a writer on digestive disorders.

Medical Chemistry and Toxicology. By JAMES W. HOLLAND, A. M., M. D. Second edition, revised and enlarged. (*Philadelphia: W. B. Saunders Company, 1908.*)

The author has crowded an immense amount of information into this volume, but has not succeeded in giving a deep, thorough and comprehensive treatment of either medical chemistry or toxicology. The book deals with all branches of chemistry of interest to the physician, but so lacks in detail that the desire to consult other sources of information is constantly arising. Unfortunately no bibliography is attached, so that the reader is often left without access to the details which he is seeking.

The section dealing with standardization of normal solutions is very vague and is not comprehensive enough for working directions for the ordinary medical student.

Too little attention has been paid to exact quantitative methods of estimation; for example, no quantitative method of estimation of creatinin or ammonia is given, while the Kjeldahl method described is crude and cumbersome when compared with such a method as that adopted by the Bureau of Chemistry, U. S. Department of Agriculture.

The space allotted to autolytic enzymes is entirely too small. Certain ferments are ascribed to certain organs, no mention being made of the species and no account taken of the difference in the distribution of these ferments in different species of animals.

The toxicology of the metals is satisfactory, generally speaking, but that of the organic vegetable preparations constantly employed by the physician has been very much neglected in parts—for instance, no toxicology at all is given of digitalis, strophanthus, ergot, and many other important drugs.

An attempt has been made to crowd too much into too small space with the result of a too superficial treatment of some subjects, while some other subjects worthy of consideration in such a book have been absolutely ignored. L. G. R.

Practical Diatetics, with Special Reference to Diet in Diseases. By W. GILMAN THOMPSON, M. D., etc. Fourth edition. Illustrated, enlarged and completely rewritten. Price, $5.00. (*New York and London: D. Appleton & Co., 1909.*)

Since the first edition of Practical Diatetics was published the treatment of disease by diet has come to hold a place of first importance. During the fifteen years which have elapsed much scientific investigation has been made.

In the present edition, while the classification of food is much the same as in the early one, many unimportant details have been eliminated, while in some cases sentences have been rewritten with a view to simplicity and better arrangement of information. Tables have been omitted which recent scientific investigations have proved inaccurate, and in estimating the equivalent elements in the different classes of food many changes have been made and new figures adopted in making the various food computations.

The results of the various recent investigations and experiments showing the difference in the body requirement at rest and at work, as determined by the measurement of the intake of air, food and water and output of oxygen, carbon dioxide and water, by Benedict and Milner, are inserted.

Many experiments showing metabolic changes have been added and the newest methods which are employed to study the energy-producing power of food in the body. A distinction is made in the use of the terms protein and proteid.

A detailed account of the experiments made through the Atwater and Rosa calorimeter at Wesleyan University with the results obtained is given in this edition. Instead of old authorities present-day investigators are quoted, such as Atwater, Sherman and Waite.

The use of chemical food preservatives has increased so much of late years as to require restriction by legislation. Dr. Wiley has made many exhaustive studies and a summary of his experiments on what was known as "The Poison Squad," published in several bulletins authorized by the Department of Agriculture, is given here. The result of the investigation, which excited so much comment that a special commission was appointed by the National Government to report upon it, signed by Professors Chittenden, Remsen, Long and Herter, is likewise published in

this volume together with another investigation by Professors Chittenden and Gies on the same subject. A report on the work of the French Commission of Public Hygiene has been added.

Laws with reference to the marketing of milk which have been enacted since the time of writing the first book are here summarized together with the methods employed by the various milk commissions formed for the purpose of supervising the transportation and production of milk so as to ensure its purity.

Plates are added showing different pieces of apparatus by which many of the modern milk tests have been made and those used for other experimental purposes in connection with model milk laboratories.

Many new ideas with reference to treatment in disease by diet are given a place in this volume. Dr. Irving Fisher of Yale is quoted with reference to food absorption, good equivalents and good portions, and the new idea of feeding in typhoid fever, as outlined by Coleman-Shaffer, has been added. Altogether the book has been rewritten so as to make it authoritative and in every way a present-day work, eliminating all the older ideas which recent experiments have proved to be valueless.

BOOKS RECEIVED.

A Textbook of Experimental Physiology. By N. H. Alcock, M. D., D. Sc., and F. O'B. Ellison, M. D. With a preface by E. H. Starling, M. D., F. R. C. P., F. R. S. 1909. 8vo. 139 pages. P. Blakiston's Son & Co., Philadelphia.

Transactions of the Association of American Physicians. Twenty-fourth session held at Washington, D. C., May 11 and 12, 1909. Volume 24. 8vo. 634 pages. Printed for the Association. Philadelphia.

Oxford Medical Publications. Diseases of the Heart. By James Mackenzie. Second edition. 1910. 8vo. 419 pages. Oxford University Press, American Branch, New York.

Ophthalmic Surgery. A Treatise on Surgical Operations Pertaining to the Eye and its Appendages, with Chapters on Para-Operative Technic and Management of Instruments. By Charles H. Beard, M. D. With 9 plates, showing 100 instruments and 300 other illustrations. 1910. 8vo. 674 pages. P. Blakiston's Son & Co., Philadelphia.

Spondylotherapy. Spinal Concussion and the Application of Other Methods to the Spine in the Treatment of Disease. By Albert Abrams, A. M., M. D. (University of Heidelberg), F. R. M. S. Illustrated. 1910. 8vo. 400 pages. Philopolis Press, San Francisco, California.

Urgent Surgery. By Félix Lejars. Translated from the sixth French edition by William S. Dickie, F. R. C. S. With 20 full-page plates and 994 illustrations, of which 602 are drawn by Dr. E. Daleine and A. Leuba, and 217 are from original photographs. Vol. 1. Introductory—Head—Neck—Chest—Spine—Abdomen. 1910. 4to. 617 pages. William Wood & Co., New York.

Oxford Medical Publications. Male Diseases in General Practice. An Introduction to Andrology. By Edred M. Corner, M. A., M. C. (Cantab.), B. Sc. (Lond.), F. R. C. S. (Eng.). 1910. 8°. 462 pages. Oxford University Press, American Branch, New York.

Oxford Medical Publications. Constipations and Allied Intestinal Disorders. By Arthur F. Hertz, M. A., M. D. Oxon., M. R. C. P. 1909. 8°. 344 pages. Oxford University Press, American Branch, New York.

Oxford Medical Publications. Diet in Tuberculosis, with Costs of Foods and Their Preparation. By Noel Dean Bardswell, M. D., M. R. C. P., and John Ellis Chapman, M. R. C. S., L. R. C. P. 1910. 8vo. 62 pages. Oxford University Press, American Branch, New York.

A Textbook of Nervous Diseases. By William Aldren Turner, M. D. (Edin.), and Thomas Grainger Stewart, M. B. (Edin.). 1910. 8vo. 607 pages. P. Blakiston's Son & Co., Philadelphia.

The Stomach, Intestines and Pancreas. By W. C. Bosanquet, M. A., M. D. Oxon., F. R. C. P., and H. S. Clogg, M. S. (Lond.), F. R. C. S. (Eng.). Edited by James Cantlie, M. A., M. B., C. M. (Aberd.), F. R. C. S. (Eng.). The Medico-Chirurgical Series No. 2. 1910. 12mo. 665 pages. William Wood & Co., New York.

Diagnostic Therapeutics. A Guide for Practitioners in Diagnosis by Aid of Drugs and Methods Other than Drug-Giving. By Albert Abrams, A. M., M. D. (Heidelberg). With 198 illustrations. [1910.] 8vo. 1039 pages. Rebman Company, New York.

Living Anatomy and Pathology. The Diagnosis of Diseases in Early Life by the Roentgen Method. By Thomas Morgan Rotch, M. D. 303 illustrations. [1910.] 8vo. 225 pages. J. B. Lippincott Company, Philadelphia and London.

Diseases of the Genito-Urinary Organs. Considered from a Medical and Surgical Standpoint, including a description of Gonorrhea in the Female and Conditions Peculiar to the Female Urinary Organs. By Edward L. Keyes, Jr., M. D., Ph. D. With 195 illustrations in the text, and 7 plates, 4 of which are colored. 1910. 8vo. 975 pages. D. Appleton & Co., New York and London.

Nutrition and Dietetics. A Manual for Students, for Trained Nurses, and for Dietitians in Hospitals and Other Institutions. By Winfield S. Hall, Ph. D., M. D. 1910. 8vo. 315 pages. D. Appleton & Co., New York and London.

Preparatory and After-Treatment in Operative Cases. By Herman A. Haubold, M. D. 1910. 8vo. 650 pages. D. Appleton & Co., New York and London.

Manual of Operative Surgery. By John Fairbairn Binnie, A. M., C. M. (Aberdeen). Vol. II. Vascular System, Bones and Joints, Amputations. Fourth edition, revised and enlarged. With 550 illustrations. 1910. 12mo. 553 pages. P. Blakiston's Son & Co., Philadelphia.

Serum Diagnosis of Syphilis and the Butyric Acid Test for Syphilis. By Hideyo Noguchi, M. D., M. Sc. 14 illustrations. 1910. 8vo. 173 pages. J. B. Lippincott Company, Philadelphia and London.

Guy's Hospital Reports. Edited by F. J. Steward, M. S., and Herbert French, M. D. Vol. LXIII, being Vol. XLVIII of the third series. 1909. 8vo. XXXVI + 385 pages. J. & A. Churchill, London.

An English Handbook to the Paris Medical School. By A. A. Warden, M. D. Second edition. (With map.) 16mo. 52 pages. J. & A. Churchill, London. P. Blakiston's Son & Co., Philadelphia.

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